Ord U613
12
TM
1941

TM 9-1585

WAR DEPARTMENT

U.S. Dept. of army

TECHNICAL MANUAL

&

ORDNANCE MAINTENANCE

RANGE FINDERS, 1-METER BASE AND 80-CM BASE, ALL TYPES

May 23, 1941

UNIVERSITY OF CALIFORNIA
LIBRARY
SEP 17 1942
DOCUMENTS DIVISION

Generated on 2017-02-23 18:00 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

U113
.2
TM9:1585
1941

TECHNICAL MANUAL
No. 9–1585

WAR DEPARTMENT,
WASHINGTON, May 23, 1941.

ORDNANCE MAINTENANCE

RANGE FINDERS, 1-METER BASE AND 80-CM BASE, ALL TYPES

Prepared under direction of the
Chief of Ordnance

318327°—41——1

M574654

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Generated on 2017-02-23 18:01 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

SECTION I

GENERAL

1. Purpose.—This technical manual is published primarily for the information and guidance of ordnance maintenance personnel.

2. Scope.—This manual supplements the technical manuals which are prepared for the using arm. It contains descriptive matter and illustrations sufficient to provide a general working knowledge of the instruments and detailed instructions for maintenance and repair by ordnance personnel. Figures which accompany the text show the placement and method of fastening of each of the component parts of the instruments. Tabulated data pertaining to the instruments are included.

3. References.—The appendix includes references to all standard nomenclature lists and other publications for the matériel described herein.

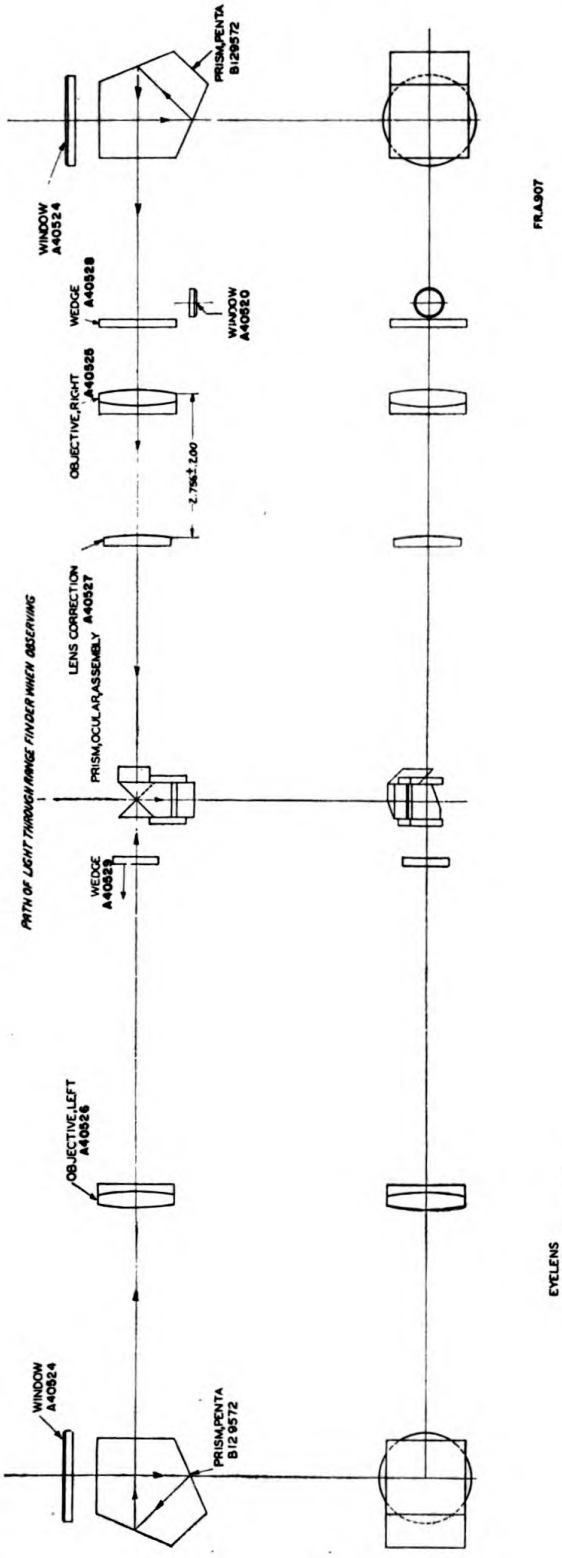
SECTION II

DESCRIPTION AND OPERATION

4. Range finders.—*a.* Range finders are optical instruments used for measuring ranges. The 1-meter base range finder, M1916, with its mount is also used for measuring angles in azimuth and site.

b. All of the instruments described herein are of the self-contained horizontal base type. The optical system of this type of instrument is designed to receive two beams of light which are refracted through two independent penta prism and objective systems to combine in the image plane of a centrally located eyepiece. The distance between the two points at which the light beams enter the instrument is referred to as the base of the instrument. The combined images

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:01 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google



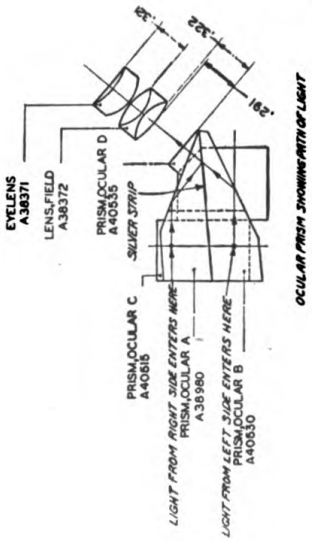


FIGURE 1.—Optical system for 1-meter base range finder, M1916.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:01 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

appear as an erect image and an inverted image, separated by a horizontal dividing line known as the halving line. In operation, when both light beams are accurately directed to intersect on a distant object, the erect and inverted images of the object coincide at the halving line, and the range to the object can then be read on a calibrated scale or range drum. The extreme range graduation is infinity (marked ∞ or with a star). This graduation represents the range to a star or other celestial body which is so far distant that the light beams are parallel when the images are in coincidence.

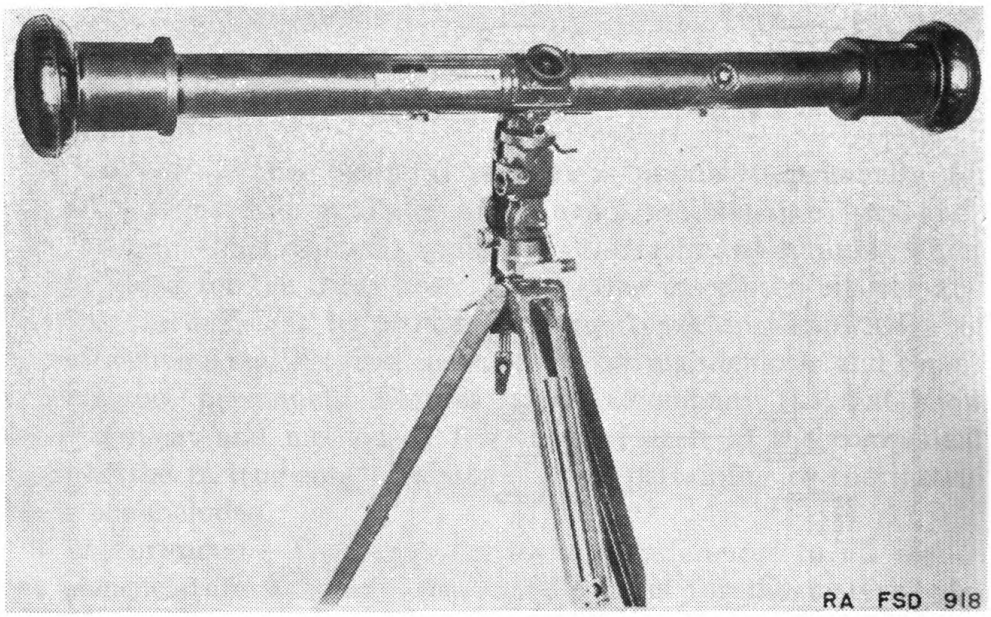


FIGURE 2.—1-meter base range finder, M1916.

c. A representative optical system is shown in figure 1. This is the optical system used in the 1-meter base range finder, M1916. The measuring wedge, A40529, moves laterally as indicated by the arrow, thereby deflecting the left light beam through an angle sufficient to provide coincidence. This wedge movement is mechanically transmitted to the range drum on which the range reading is made. Wedge, A40528, is provided for correction adjustment purposes. The penta prisms are designed to bend the light beams through an angle of 90°.

d. Figures 2 to 6, inclusive, show the external appearance of the several range finders described herein.

5. Optical repair kit for Field Artillery.—An optical repair kit containing the necessary tools, fixtures, cements, oils, etc., for use with these instruments is furnished to ordnance maintenance com-

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:01 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

panies. A complete list of the items comprising the kit is contained in a blueprint which is fastened in the cover of the chest. Every item in the kit is designated by a number equivalent to the

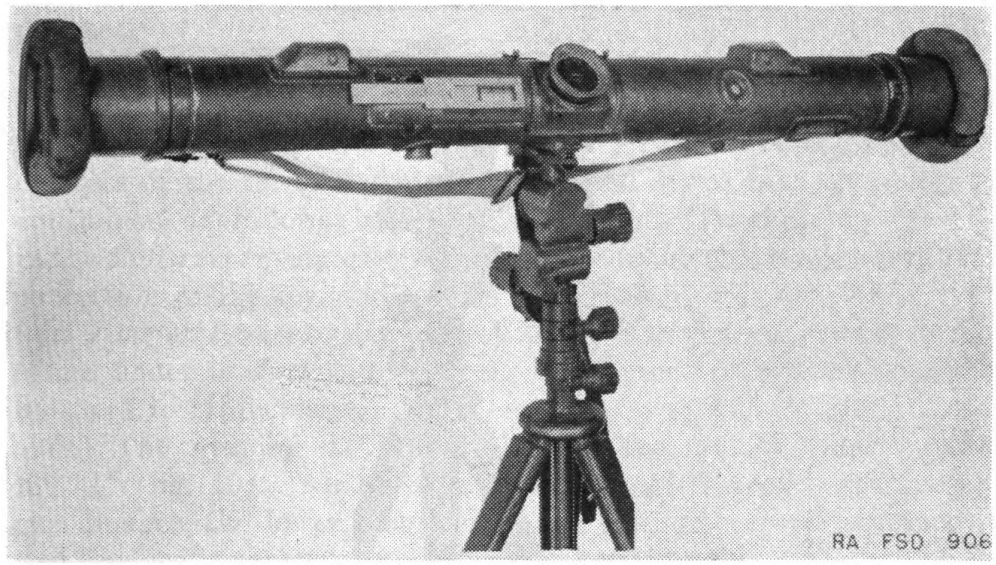


FIGURE 3.—80-cm base range finder, M1914.

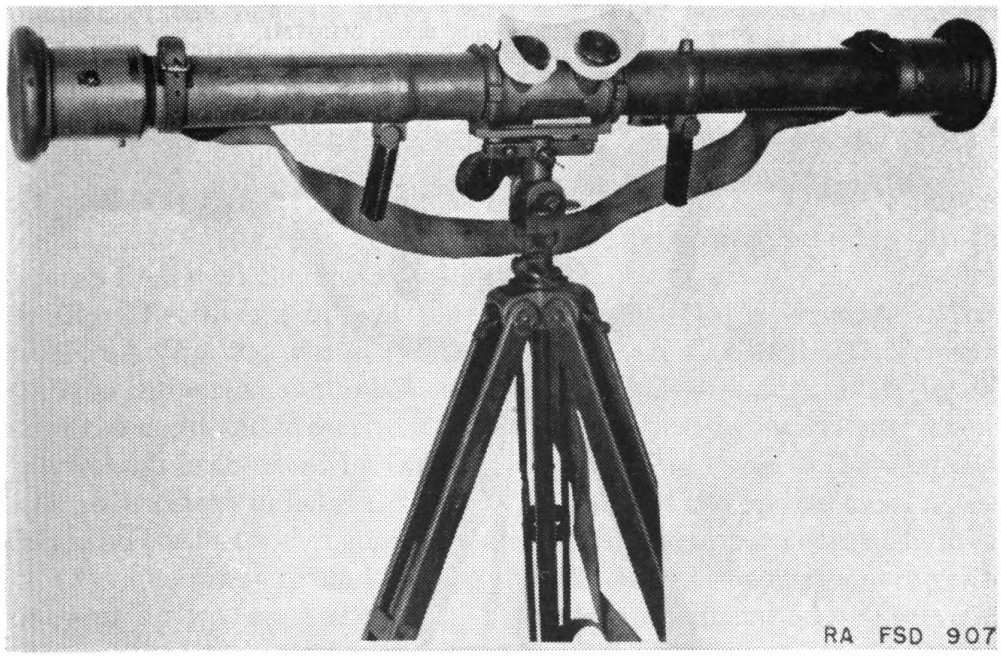


FIGURE 4.—80-cm base range finder, M1916.

compartment number. Most of the items such as screw drivers, etc., require no description as their uses are self-explanatory. The collimating telescope, No. 90, which is furnished with the kit is an ordi-

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:01 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

nary nonerecting type. It is adjusted for parallax by the usual means of focusing the eyepiece on the cross wires and then removing parallax by focusing the objective, temporarily loosening the draw-

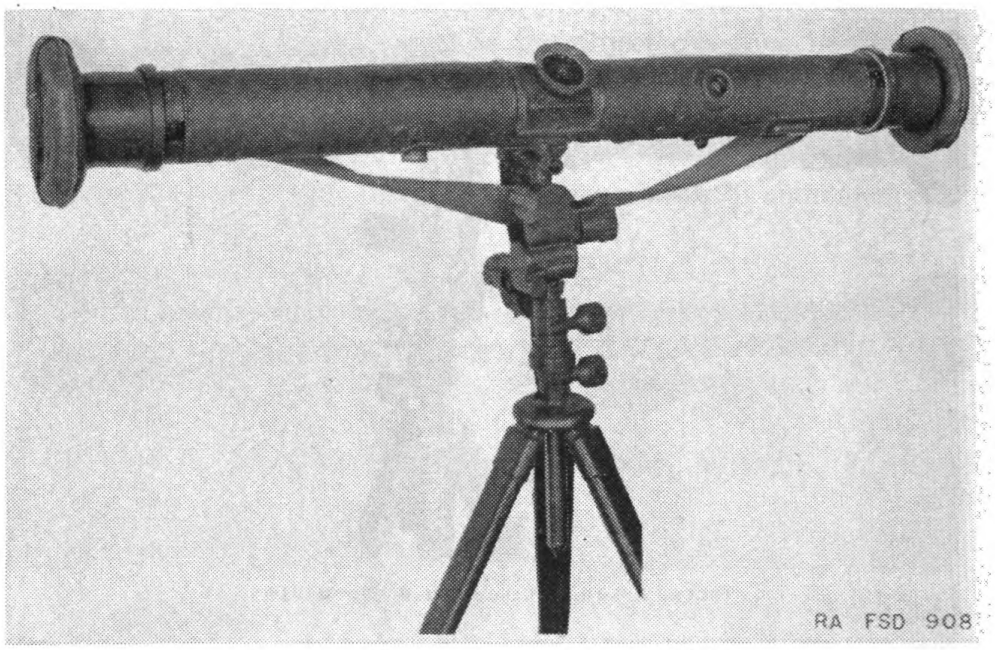


FIGURE 5.—80-cm base range finder, M1917MI.

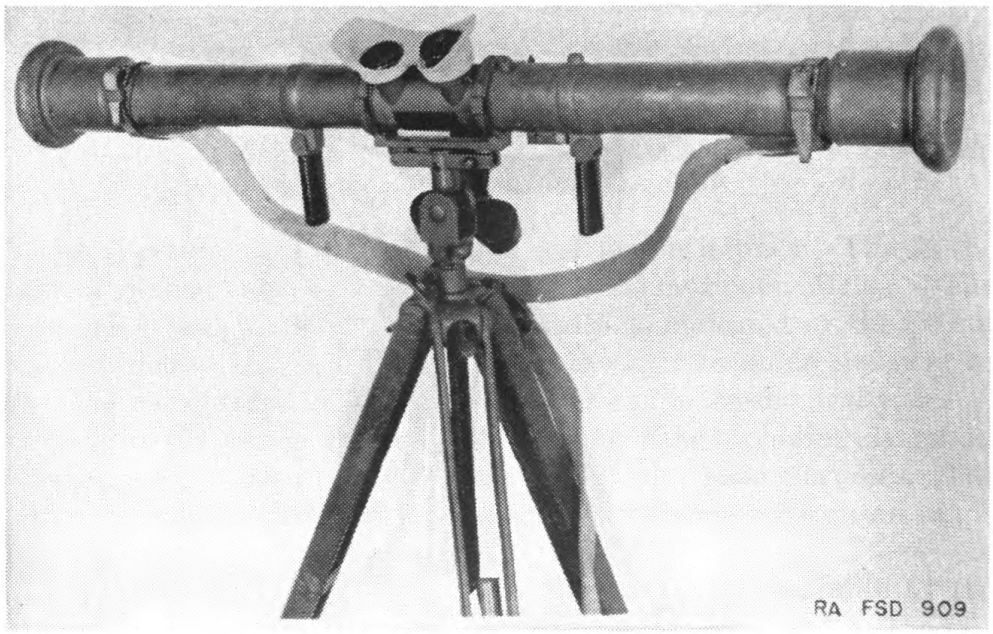


FIGURE 6.—80-cm base range finder, M1918.

tube clamping screw in the side of the telescope for the purpose. The magnifying power of the collimating telescope is 9.78X; the field of view is 4°20′.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:01 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

SECTION III

1-METER BASE RANGE FINDER, M1916

6. Description.—The 1-meter base range finder, M1916, complete, consists of the range finder, mount, tripod (type U), and accessory equipment as follows: adjusting lath (type C), carrying case for range finder, carrying case for tripod with mount and adjusting lath, correction wedge key, and camel's-hair brush.

a. 1-meter base range finder, M1916.—The optical system of this range finder is shown in figure 1. Mechanical details are shown in figures 7 to 11, inclusive.

(1) The eyepiece is focused by rotation of the diopter scale, X174C (fig. 10). An object viewed through the eyepiece presents two images, the lower image erect and the upper inverted, and the two images separated by a horizontal dividing line known as the halving line. A short vertical line in the lower field indicates the center of the field of view. The ray filter lever, X140A (fig. 7), near the eyepiece controls a ray filter holder, X144C (fig. 10), containing an amber ray filter, A40518, and a smoked ray filter, A40519. The amber ray filter is used to moderate exceptionally bright daylight or the reflection of the sun over water; the smoked ray filter is used for observing into the direct rays of a searchlight. The open sight, A578 (fig. 7), near the eyepiece facilitates training of the range finder on the desired object.

(2) The central optical parts are mounted in a separate optical tube, 6A (fig. 9), within the outside tube, 5A (fig. 10). This optical tube is supported at the left end in the gimbal joint fork, 13H (fig. 9), and the right end is carried in the halving adjusting swivel ring assembly which is actuated by the halving adjusting knob, X71F (fig. 10), for adjustment in height. The appearance of the optical tube, assembly, and the method of support are shown in the upper views of figure 8.

(3) The range drum knob, 8F (fig. 9), simultaneously operates the measuring wedge, A40529 (fig. 8), and range drum, 8A. The range drum is spirally graduated and is read against the index line of the range pointer, A40511. The graduations are in yards unless otherwise marked on the range window cover, A550.

(4) The correction wedge shaft, X143A (fig. 10), operates the correction wedge, A40528 (fig. 9), and the correction wedge scale, 7D. The

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:01 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

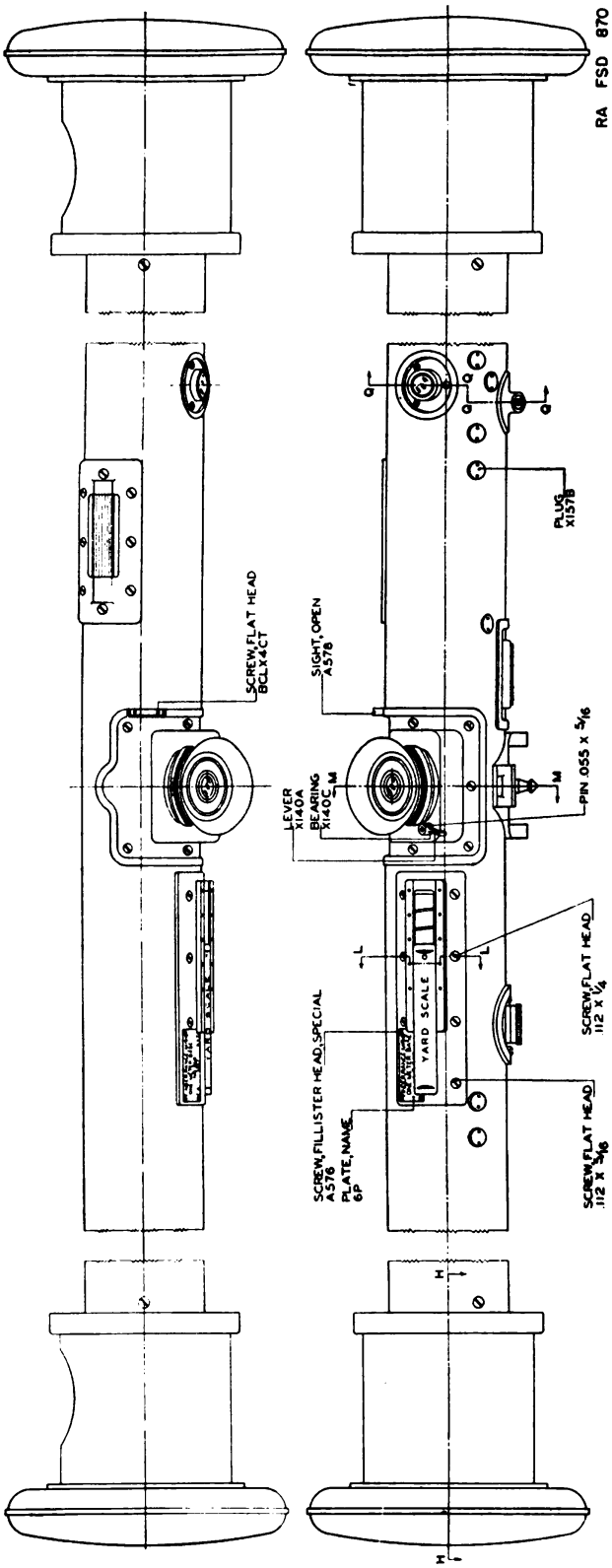


FIGURE 7.—1-meter base range finder, M1916—assembled views.

Generated on 2017-02-23 18:01 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

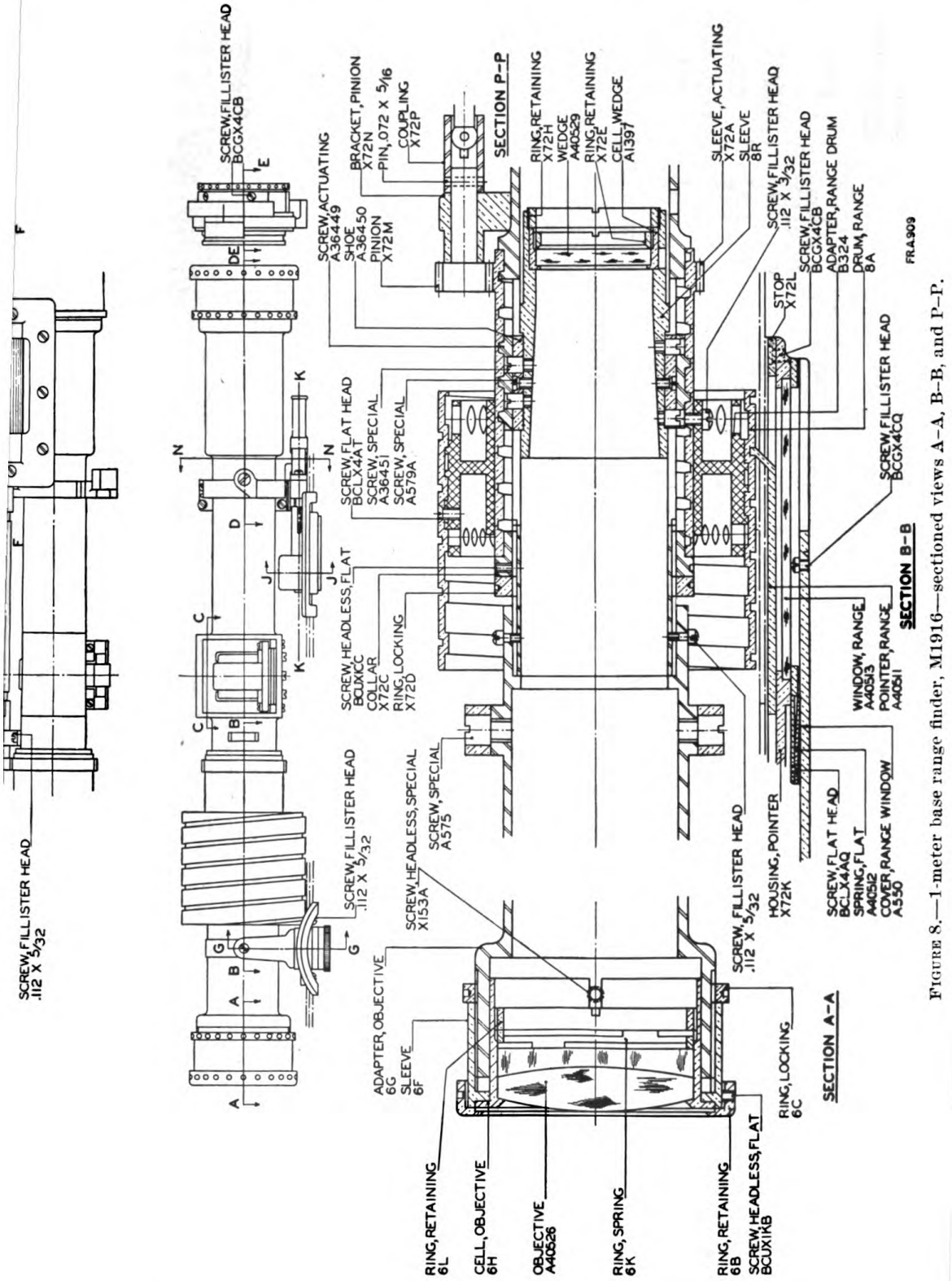


FIGURE 8.—1-meter base range finder, M1916—sectioned views A–A, B–B, and P–P.

Generated on 2017-02-23 18:01 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

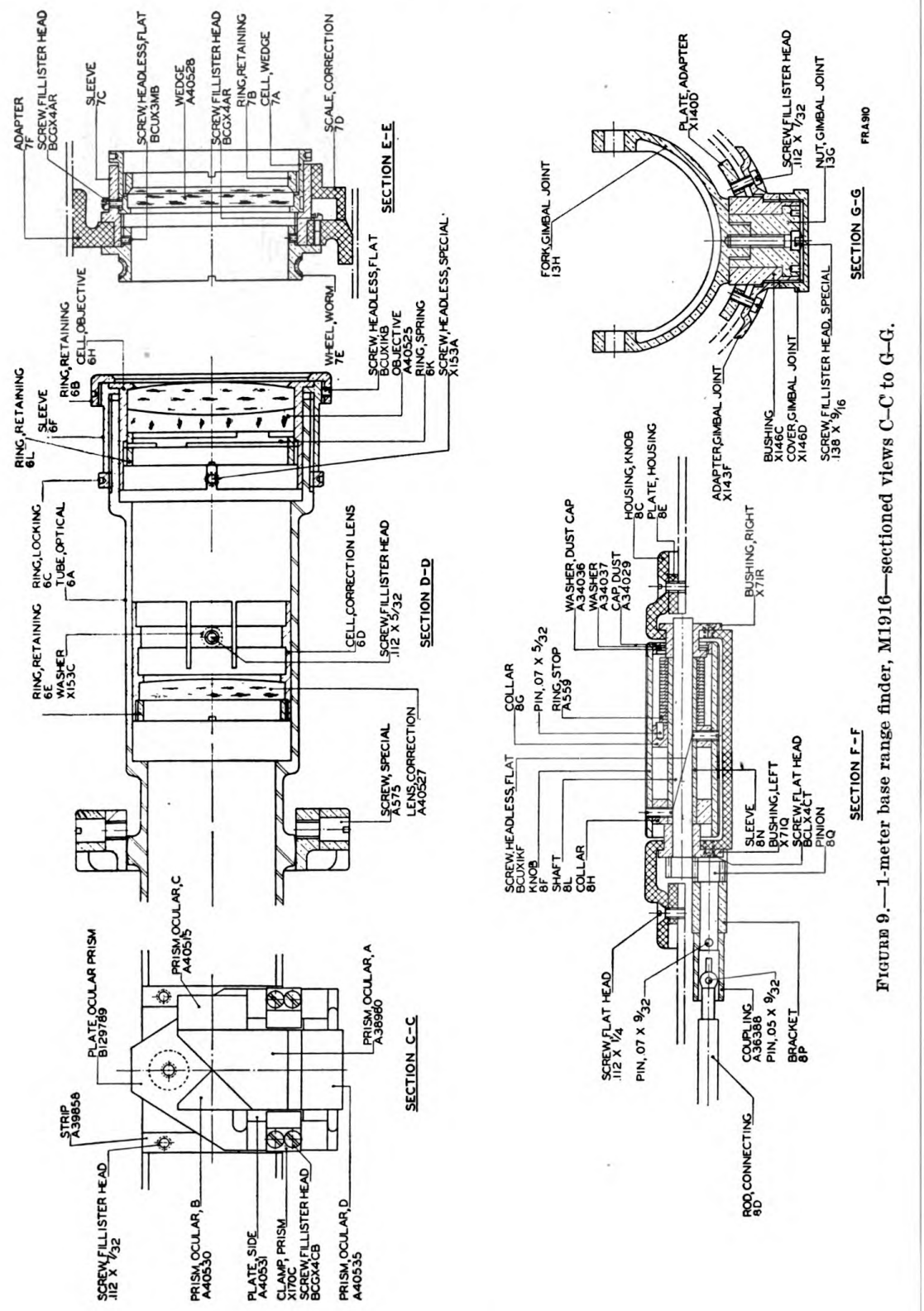


FIGURE 9.—1-meter base range finder, M1916—sectioned views C–C to G–G.

Generated on 2017-02-23 18:02 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

graduations of this scale are in arbitrary units. A correction wedge key is supplied with the instrument to fit the squared end of the shaft.

(5) The end box assemblies at each end of the outside tube, 5A (fig. 10), contain the penta prisms, B129572 (fig. 11), and the end box windows, A40524. The end box windows are optical wedges which are carefully adjusted in manufacture to compensate for combined deviations of the optical system. The end box sleeves, 14A, can be rotated to cover the window openings and thereby guard against the entrance of dirt or dust. The buffer assemblies, B136403, are provided as a protection against minor shocks.

(6) The range finder adapter, X142A (fig. 10), fastened to the outside tube below the eyepiece is the means for attaching the range finder to the support on the upper portion of the mount.

(7) The optical characteristics of the range finder are as follows:

Power	15X
Field of view	3°10′
Diameter of exit pupil	0.1 inch
Aperture of objective	1.5 inches
Effective focal length of objective	8.66 inches

b. Mount for 1-meter base range finder, M1916.—(1) The mount (fig. 12) positions the line of sight of the range finder in elevation and azimuth and provides a hinge joint for placing the base line axis of the instrument in either a vertical or a horizontal position. Mechanical details of the mount are shown in figures 13 and 14.

(2) The lower portion of the mount contains the azimuth and orienting mechanisms and the upper portion contains the elevation and angle of site mechanisms. The upper portion is hinged to the lower portion and is clamped thereto by means of the clamping screw handle, A33709 (fig. 14). With the clamp released, the range finder can be turned down to the right into a vertical position so that observations are made in the vertical plane. When the range finder is so used, the support clamping lever, X59B (fig. 13), can be released to permit a limited amount of motion in elevation.

(3) The angle of site and azimuth mechanisms are graduated in accordance with the system used in field artillery sighting matériel. The angle of site graduations read from 0 to 600 mils, and the 300-mil graduation represents the horizontal position. The azimuth graduations read from 0 to 6400 as well as 0–3200, 0–3200.

(4) The azimuth worm throwout lever, X67F (fig. 14), when rotated and held, disengages the azimuth worm, 22E, from the teeth of the worm gear, 21H, thereby permitting rapid approximate setting in azimuth.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:02 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

c. Tripod, type U.—The tripod, type U (fig. 15), is issued for use with this instrument. The mount is retained in the tripod head, X60A, by means of the locking screw, X219C, and is clamped

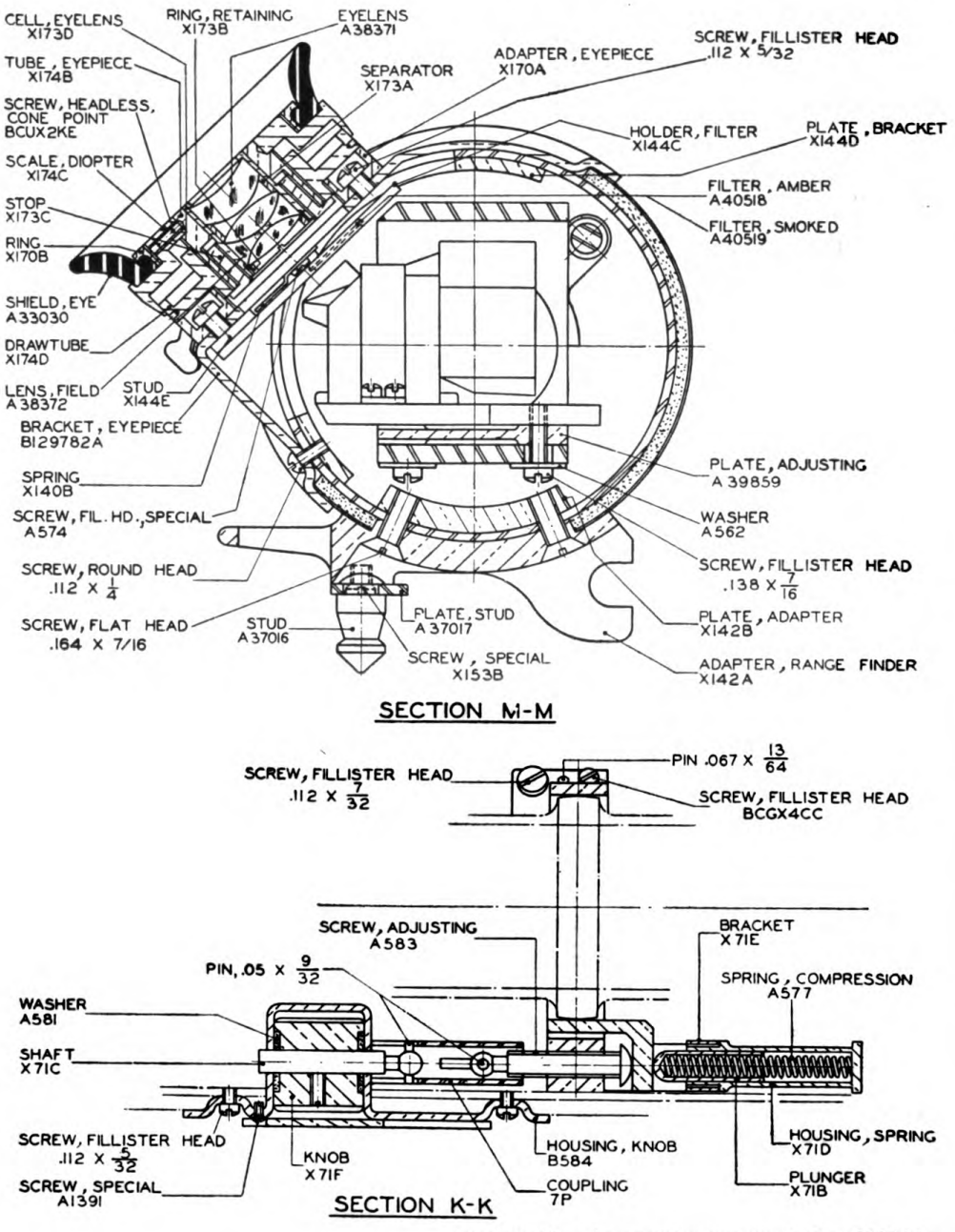
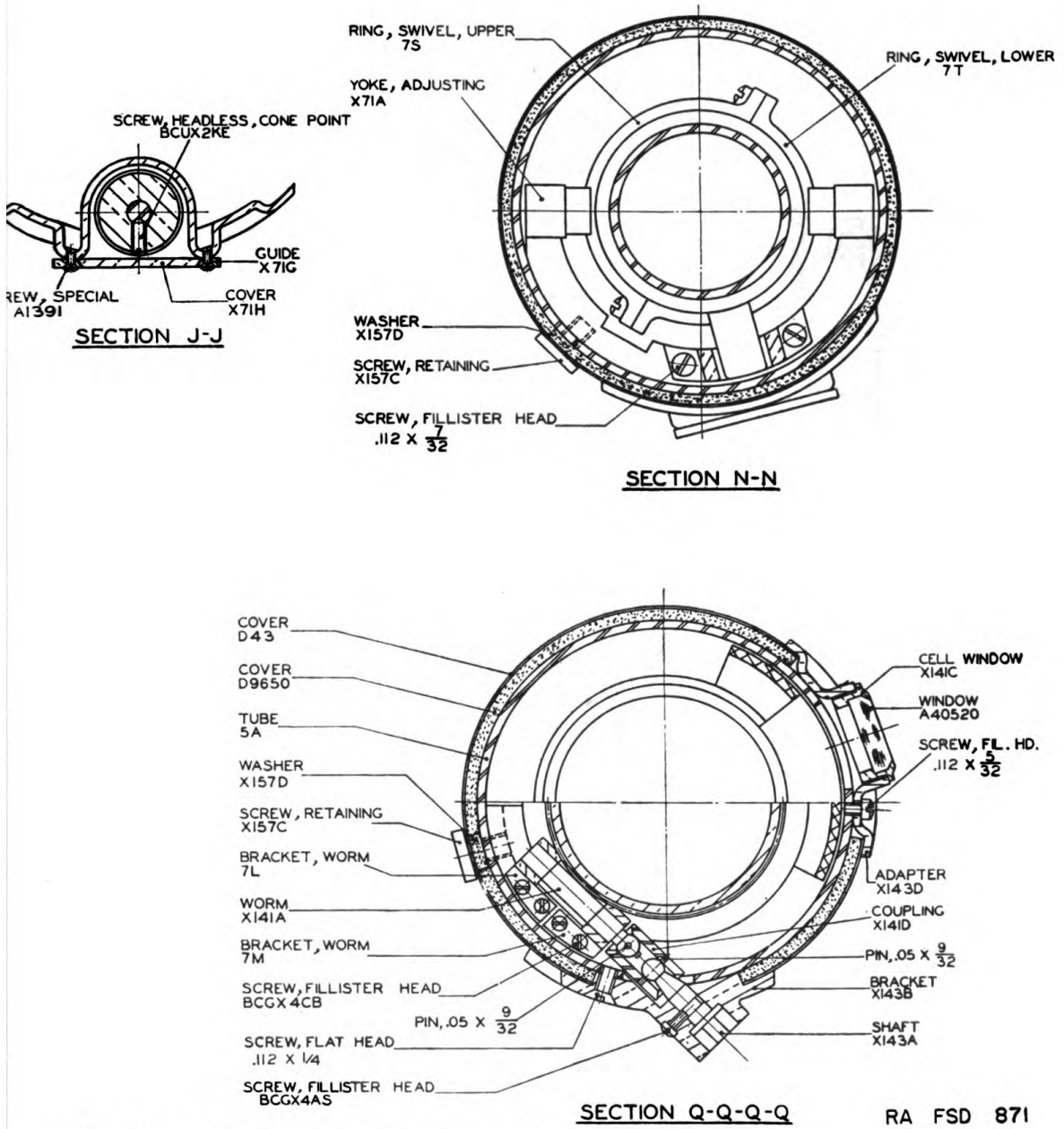


FIGURE 10.—1-meter base range finder, M1916—

against rotation in azimuth by means of the tripod head bushing clamping screw lever, X59B. The tripod legs are extensible and are fitted with clamping devices at the head and at the telescoping portion.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:02 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

d. Adjusting lath, type C.—The adjusting lath, type C (fig. 16), consists of a metal body, C118B, carrying two accurately spaced index strips, X73A, with the distance between strips equal to the



sectioned views J–J, K–K, M–M, N–N, and Q–Q–Q–Q.

base of the range finder. Each adjusting lath is individually adjusted and bears the same serial number as the range finder. The sight assembly is removable to permit placing the adjusting lath in the carrying case.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:03 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

e. Carrying cases.—The carrying case for the 1-meter base range finder (fig. 17) is a simple tubular case fitted with a removable lid assembly. It is constructed principally of leather. The carrying

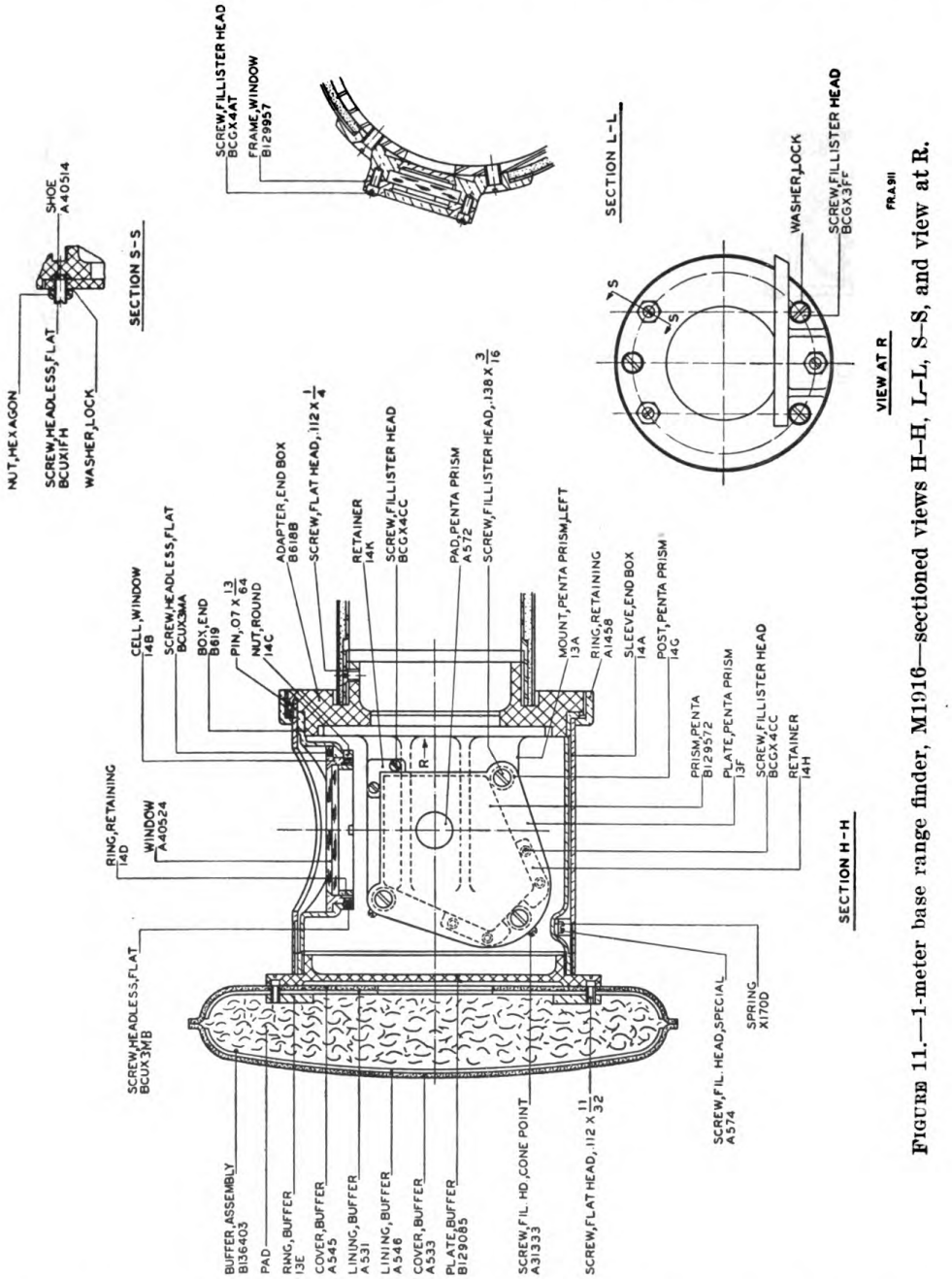


FIGURE 11.—1-meter base range finder, M1916—sectioned views H–H, L–L, S–S, and view at R.

case for the tripod, mount, and adjusting lath (fig. 18) is similarly constructed but is formed with an internal pocket which contains the adjusting lath when the sight assembly is removed therefrom.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:04 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

The lid assembly is provided with a flap which holds the sight assembly, correction wedge key, and camel's-hair brush. The mount remains assembled to the tripod when placed in the carrying case.

7. Operation.—*a. Range measurement.*—(1) To measure the range of an object, select a clearly defined part, perpendicular if possible, to the halving line. Move the instrument in azimuth and

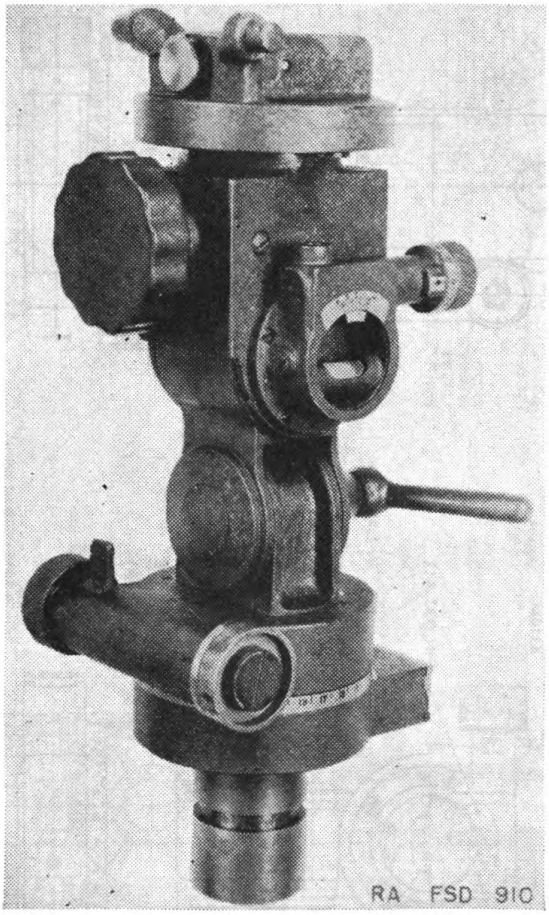


FIGURE 12.—Mount for 1-meter base range finder, M1916.

elevation as required to bring the selected part to the center of the field of view. When first observed, the images will ordinarily not be in coincidence (fig. 19①). Turn the range drum knob until the images of the point selected appear in coincidence (fig. 19②). Read the range, in yards, on the range drum, opposite the sliding range pointer.

(2) To measure the range of horizontal objects, such as roads, trenches, crests of ridges, etc., which have no prominent vertical parts, turn the instrument with the longitudinal axis vertical. This

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:04 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

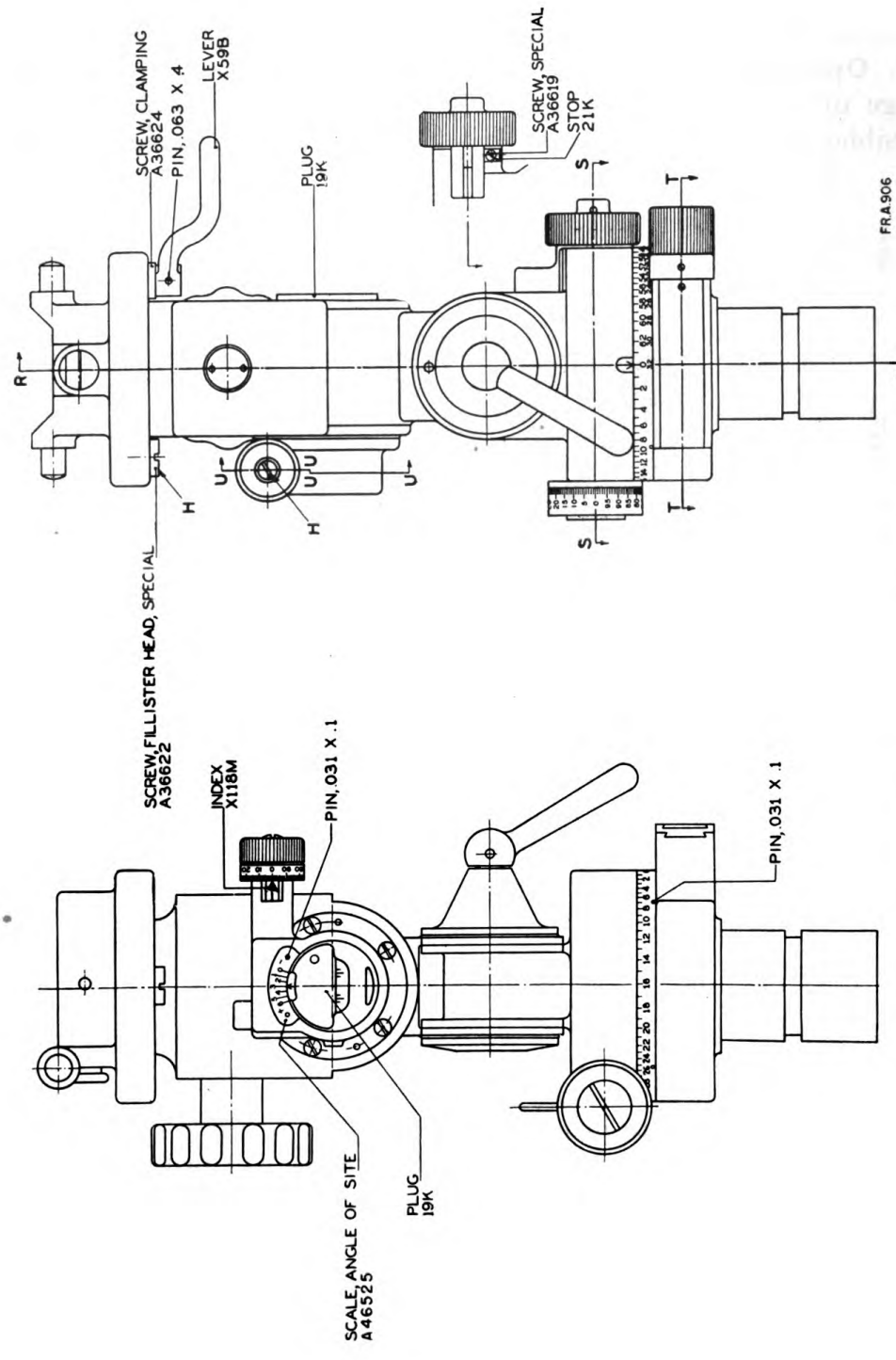


FIGURE 13.—Mount for 1-meter base range finder, M1916—assembled views.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:04 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

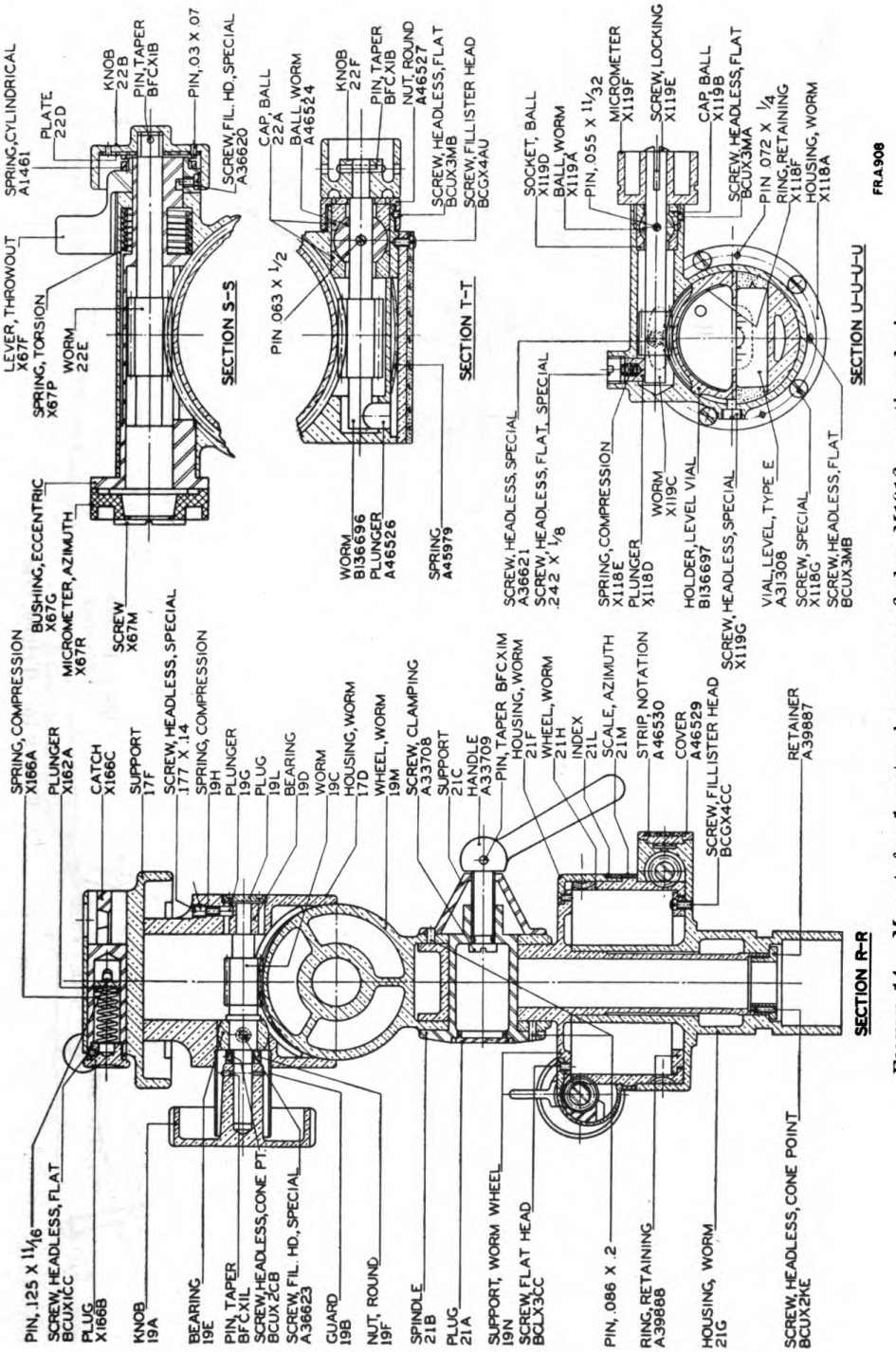


FIGURE 14.—Mount for 1-meter base range finder, M1916—sectioned views.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:05 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

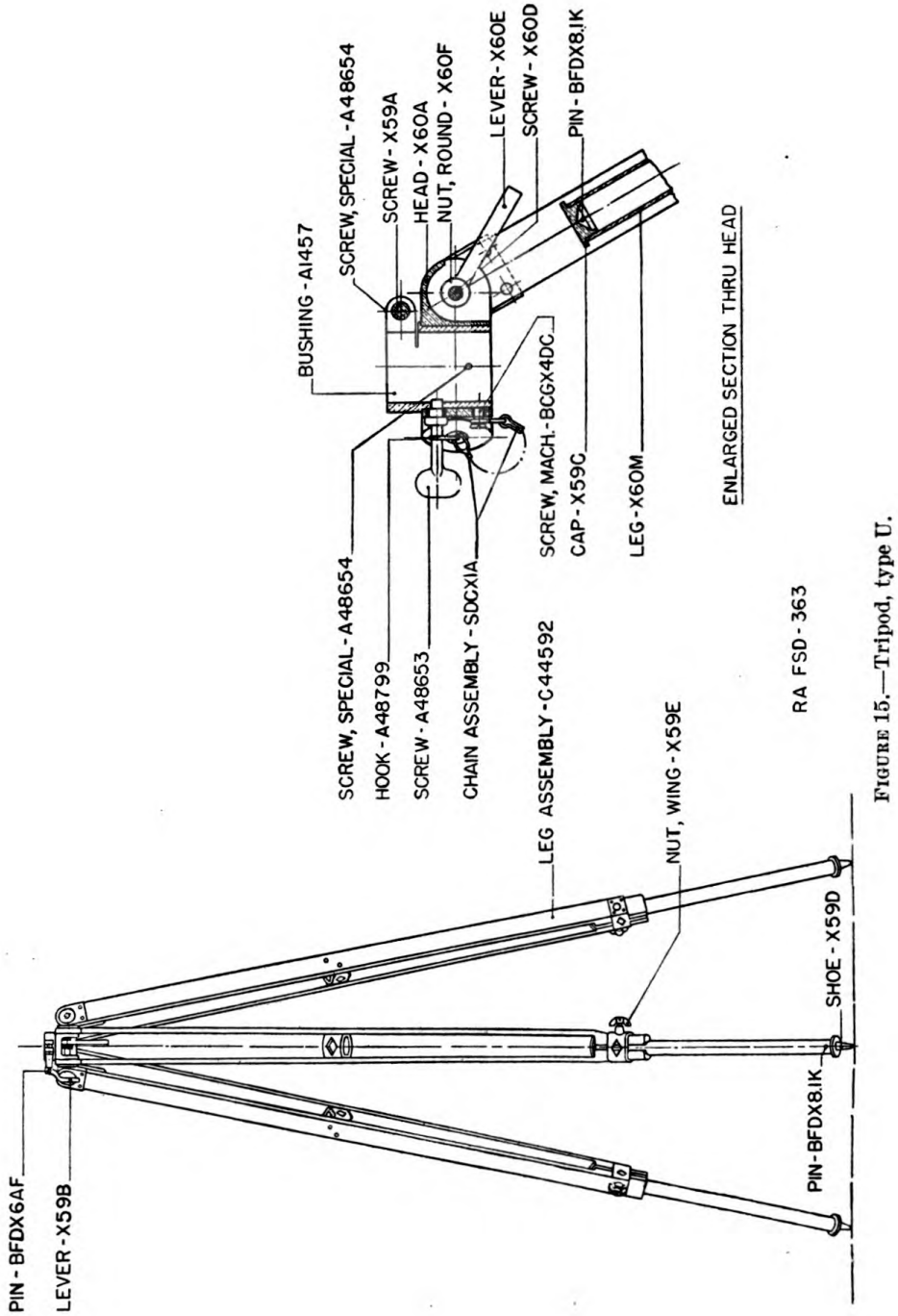


FIGURE 15.—Tripod, type U.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:05 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

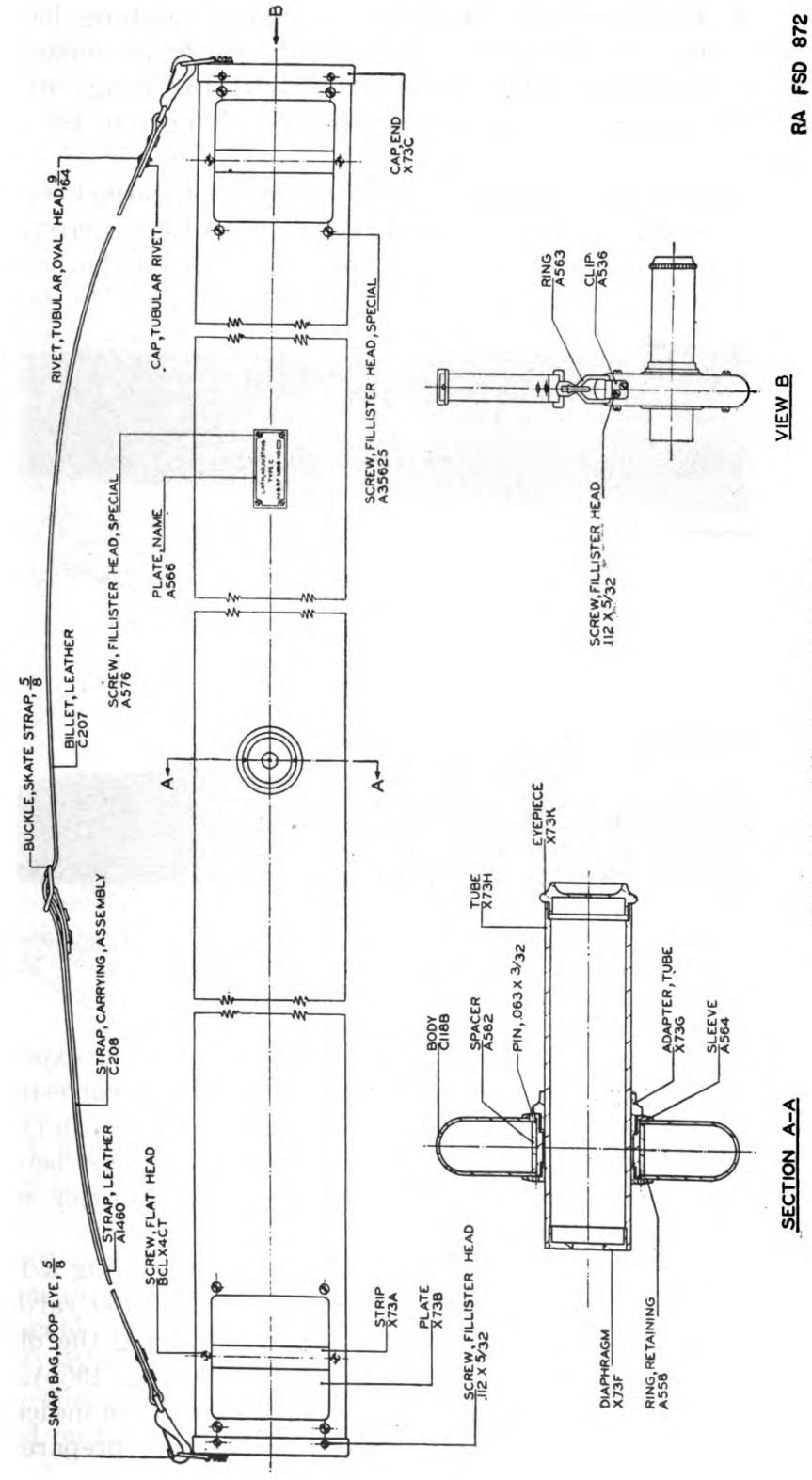


FIGURE 16.—Adjusting lath, type C.

Generated on 2017-02-23 18:05 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

can be done by temporarily loosening the hinge clamping handle. The images when first observed will ordinarily not be in coincidence (fig. 19③). Turn the range drum knob until the image of the horizontal line appears to continue across the halving line (as at A in fig. 19④).

b. Field adjustment.—(1) *Halving adjustment.*—Incorrect adjustment of the halving line is indicated by the failure of the corresponding points on the inverted and erect images to fall on the halving

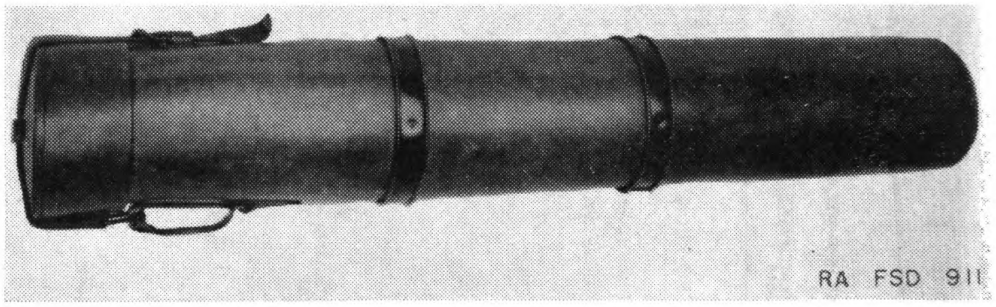


FIGURE 17.—Carrying case for 1-meter base range finder, M1916.

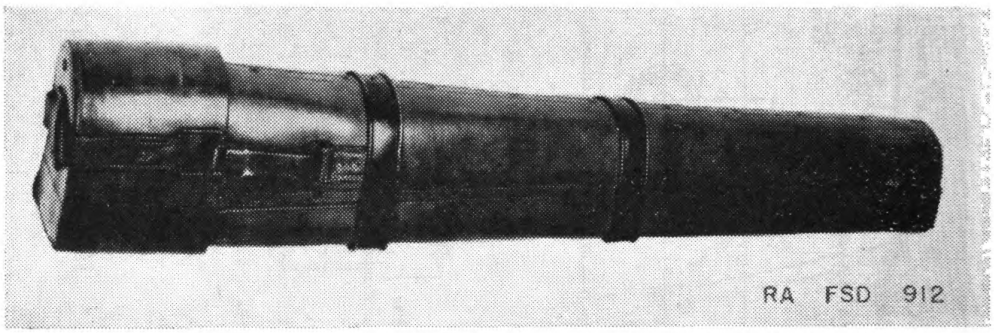


FIGURE 18.—Carrying case for tripod, mount, and adjusting lath, type C.

line (fig. 20). To correct the halving, slide back the cover exposing the halving adjusting knob and rotate the knob until the corresponding point of each image touches the halving line (as in fig. 19① and ②). A sharply defined point at least 400 yards away must be used for this adjustment. Return the cover to its original position when the adjustment is completed.

(2) *Range indications.*—(*a*) To test the instrument using a finite range, select a sharply defined object at a distance of 400 yards or more, the range of which is accurately known, and bring the object into coincidence in the center of the field of view (fig. 19②). If the range adjustment is correct, the known range should be indicated.

(*b*) To test the instrument by the infinity method, prepare the adjusting lath by inserting the sight assembly (carried in the pocket

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:05 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

flap of the carrying case). Place the adjusting lath in a horizontal position at least 100 yards from the instrument. Use the sight on the lath to insure perpendicularity to the line of sight. Set the range drum to indicate infinite range (∞). If the images appear alined as in figure 21② the adjustment is correct; misalinement, such as is shown in figure 21①, indicates the necessity for adjustment.

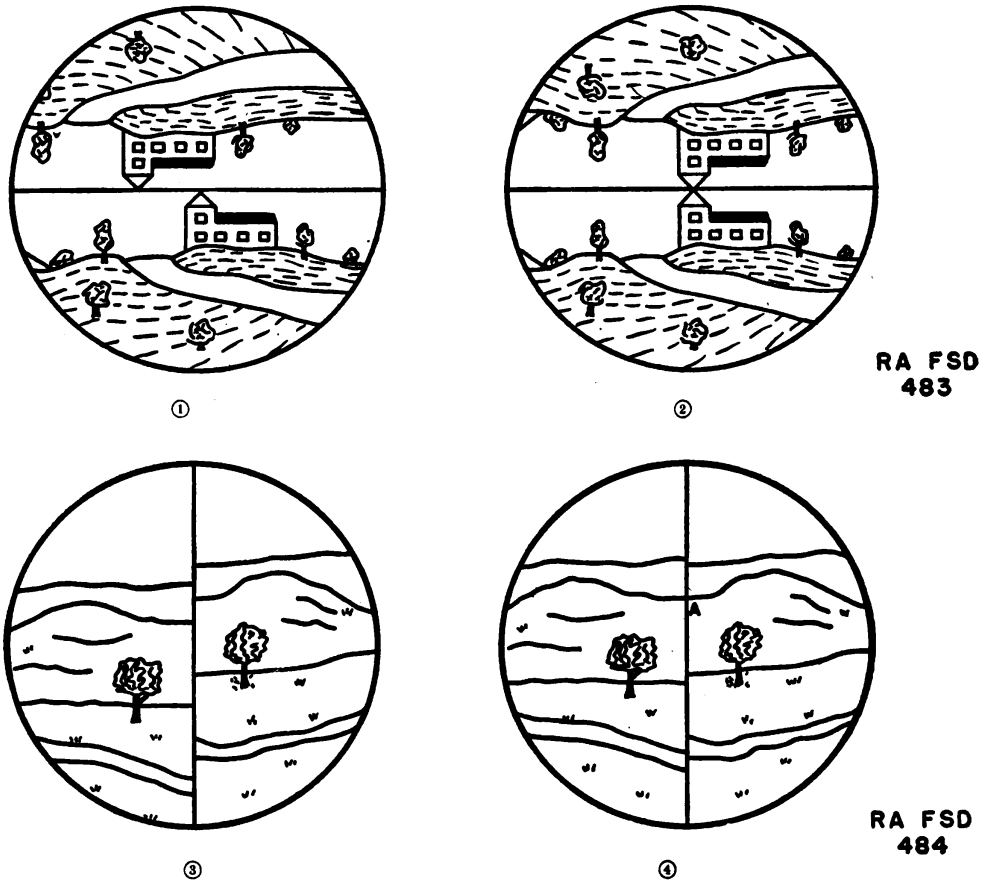


FIGURE 19.—Fields of view.

(*c*) To adjust the instrument in range, set the range at the known range or at infinity (∞), depending on the method of test employed, and bring the images into correct relation, using the correction wedge key (accessory) to turn the correction wedge shaft. Note the indication on the correction wedge scale, repeat several times, and set the scale to the average of the readings.

(*d*) When the adjusting lath is used, it must be the one belonging with the particular range finder. The same serial number is provided on both.

Generated on 2017-02-23 18:05 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

(3) *Azimuth indications.*—Should the azimuth scale and micrometer fail to indicate zero simultaneously, temporarily loosen the locking screw, X67M (fig. 14), in the end of the micrometer and slip the micrometer around as required.

(4) *Angle of site indications.*—Sight on a point at least 400 yards distant at the same level as the range finder. The angle of site

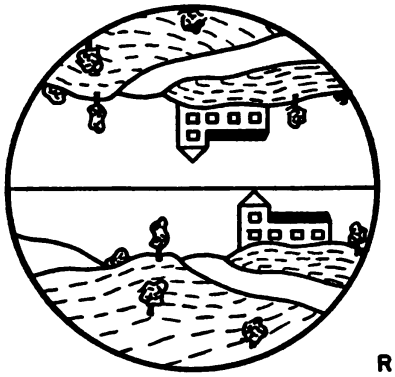


FIGURE 20.—Incorrect halving adjustment.

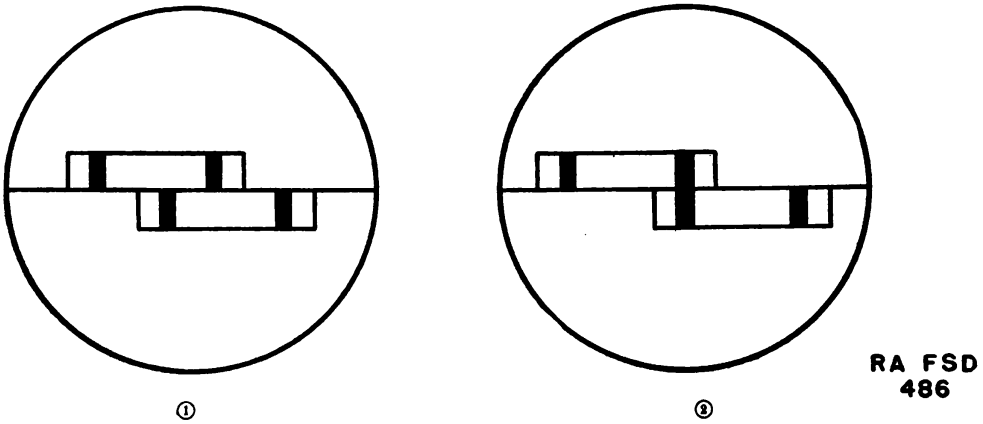


FIGURE 21.—Views when using adjusting lath.

indication should be "normal" (300 mils). Correction for small errors may be applied by temporarily loosening the locking screw, X119E, in the end of the angle of site micrometer and slipping the micrometer to the correct indication.

c. Accuracy of measurements.—The error which a practiced observer may make under the most favorable conditions is shown in the following table:

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:05 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Range in yards	*Average error, yards*
500	2
1,000	5
2,000	25
4,000	60
5,000	100
6,000	140
8,000	250
10,000	400

8. Inspection.—Inspection is for the purpose of determining the condition of the instrument, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning.

a. Range finder.

Parts to be inspected	*Points to be observed*
(1) Exposed mechanical parts.	(1) Observe general appearance, smoothness of operation of knobs, end box sleeves, ray filter lever, etc., and bent or missing parts.
(2) Open sight.	(2) Line of sight should intersect optical line of sight within a tolerance of approximately 10 mils.
(3) Eyeshield.	(3) The eyeshield requires replacement if torn or otherwise damaged.
(4) Optical system.	(4) Note if checks or frost patterns appear in the field of view. Such defects are evidence of loosening of the balsam used in cementing prisms and lenses and, if severe, require the return of the instrument to an arsenal for overhaul.
(5) Diopter scale.	(5) Using the collimating telescope (optical repair kit, No. 90), focus the eyepiece for sharpness and clearness of definition of the halving line and of both images. The reading of the diopter scale at optimum focus should be approximately zero. If not, diopter scale should be reset as in paragraph 9*a*(2).

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:06 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Parts to be inspected	*Points to be observed*
(6) Correction lens.	(6) Bring an object into coincidence in the center of the field of view, then turn the range finder in azimuth to bring the image to the edges of the field. If the image does not remain in coincidence, the correction lens is out of adjustment.
(7) Gimbal joint.	(7) Rotate halving adjusting knob to its limits. At each limit operate range drum knob to cover entire scale of range drum. Note if drum rubs on inside of outer tube, which indicates gimbal joint out of adjustment.
(8) Halving adjustment.	(8) Adjust range finder to correct halving. If proper adjustment cannot be obtained, or if halving adjusting knob is very near its limit, halving adjustment mechanism requires overhaul.
(9) Correction wedge.	(9) Adjust instrument for range, preferably using a datum point of known range. If proper adjustment cannot be obtained, or if correction wedge scale indicates too far from center, the correction wedge mechanism is out of adjustment.
(10) Prisms.	(10) Check a sharply defined object for halving at each edge and at the center of the halving line. If halving cannot be maintained without readjustment, it is an indication that the ocular or penta prisms have shifted.
b. Mount.	
(1) Exposed mechanical parts.	(1) Observe general appearance, smoothness of operation, and bent or missing parts.
(2) Worm mechanisms.	(2) Operate azimuth worm, elevating worm, and angle of site worm through entire range. Check for backlash and longitudinal play.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:06 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Parts to be inspected	*Points to be observed*
(3) Angle of site mechanism.	(3) Place the range finder on the mount and sight on a point at the same level as the range finder. Center the level bubble. The "3" graduation of the angle of site scale should then be opposite the index. (The micrometer reading may be disregarded as micrometer adjustment is performed by the using arm.)
c. Adjusting lath.	
(1) Exposed mechanical parts.	(1) Note loose or missing screws, end caps, straps, and strap rings. Test the sight tube threads by screwing the sight tube in place.
(2) Name plate.	(2) Serial number of adjusting lath should be the same as range finder.
(3) Straightness.	(3) If bent so that the space between index lines is shortened, the lath should be corrected.
(4) Alinement.	(4) Set up the range finder on its tripod and mount or on V-blocks (optical repair kit, No. 75). Place the adjusting lath at a distance of 100 yards in front of the range finder and parallel to it so that the range finder appears in the center of the field of view when sighting through the peep sight of the lath. Check the range adjustment against a fixed reference target at medium distance (500 to 2,000 yards), the range of which is accurately known. Make four or five check readings and then set range drum to read infinity. Direct the range finder on the adjusting lath. If the right index strip of the inverted image of the adjusting lath is in exact coincidence with the left index strip of the erect image, the index strips are properly spaced.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:06 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

9. Maintenance and repair.—Repairs which necessitate disassembling and assembling operations are limited to those which do not affect the optical alinement of the instrument. Repairs involving realinement, removal, or replacement of optical parts, or other repairs which cannot be made with the facilities available will require that the instrument be turned in to the base shop.

a. Range finder.—(1) *Eyeshield.*—The eyeshield is of soft rubber, molded to fit between the grooves of the diopter scale and eyeshield ring. It can be removed by unscrewing the eyeshield ring. Be careful not to damage the threads in replacing. Use lukewarm water to clean the eyeshield. Replace eyeshield if torn or otherwise damaged.

(2) *Diopter scale.*—The diopter scale can be removed or reset by backing off the three headless cone point screws which are exposed after disassembling the eyeshield and eyeshield ring. These screws fit into a V-groove in the eyepiece tube and if backed off sufficiently allow the scale to be lifted free. When replacing the diopter scale, focus the eyepiece to present a sharp image when viewed through the collimating telescope (optical repair kit, No. 90), set the diopter scale to indicate zero at this focus, and secure in position. Make certain that the headless screws seat below the surface before replacing the eyeshield and eyeshield ring.

(3) *Open sight.*—If the open sight is out of alinement and cannot be bent back into alinement, replace with a new sight.

(4) *Dismounting.*—Dismounting is accomplished through the right-hand end of the range finder. The procedure outlined below must be carefully followed in order to maintain the alinement of the optical parts.

(*a*) Remove right end buffer assembly (right-hand thread).

(*b*) Remove end box sleeve.

(*c*) Remove end box retaining ring, A1458 (fig. 11), using spanner wrench.

(*d*) Remove end box, B619. Mark position. The end box is secured to its adapter by three drive pins.

(*e*) Remove right penta prism mount, 13B, by removing the three fillister head screws. *Do not disturb the headless adjusting screws or their hexagon locking nuts.*

(*f*) Remove end box adapter, B618A, secured by three flat head screws in outside tube and threaded in place. Mark position.

(*g*) Remove correction scale window adapter, X143D (fig. 10), with window and cell.

(*h*) Remove correction wedge shaft bracket, X143B, and coupling, X141D.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:05 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

(*i*) Remove two external screws securing correction wedge mounting adapter, 7F (fig. 9), and pull adapter out through end of tube, using drill rod hooks.

(*j*) Remove range pointer housing, X72K (fig. 8) (8 screws, one under name plate).

(*k*) Remove eyepiece bracket, B129782A (fig. 10), secured by 7 screws. Before removing the last screw, hold the bracket plate by means of wires hooked through empty screw holes to prevent the plate from falling into the interior and possibly damaging the ocular prism assembly. Mark locating lines around bracket to insure proper position when reassembling.

(*l*) Remove range drum knob housing, 8C (fig. 9), and connecting rod, 8D.

(*m*) Remove screws holding gimbal joint adapter, X143F. Open gimbal joint cover, X146D, and remove the special fillister head screw and gimbal joint nut, 13G.

(*n*) Remove the two external retaining screws, X157C (fig. 10), which secure halving adjusting yoke, X71A. Move optical tube slightly to the right to facilitate uncoupling halving adjuster.

(*o*) Remove halving adjustment knob housing, B584, with knob parts and coupling.

(*p*) Remove range finder adapter, X142A.

(*q*) Withdraw optical tube assembly from outside tube through right side, tipping gimbal joint fork to allow free passage. Adapter plates are removed at the same time.

(*r*) Place optical tube in V-blocks properly set.

(*s*) Extreme care must be taken during these operations to prevent entrance of foreign matter to the interior of the instrument.

(5) *Reassembling.*—In assembling, all screws will be shellacked under head and all outside joints sealed. Screws which will be disturbed in adjusting will not be shellacked until all adjustments have been made.

(*a*) Place adapter plates on optical tube in their proper positions. Slide optical tube assembly into outside tube. Exercise care that ocular prism does not bear on the tube to avoid possible chipping of the ocular prism.

(*b*) Couple halving adjuster. Do not tighten gimbal joint until halving has been coupled. Gimbal joint and halving adjuster should then be firmly fixed in position. Set halving adjuster midway in its movement. If adapter screws are of different lengths, use a short screw over the coupling to allow free movement. To locate the

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:06 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

adapter plates properly in these operations, use short lengths of drill rod threaded to fit the screw holes.

(*c*) Couple range drum knob. Connect so that end of movement is properly limited by the stop rings, A559 (fig. 9), in the range drum knob. Fasten range drum knob housing, 8C.

(*d*) Replace range pointer housing, X72K (fig. 8).

(*e*) Replace correction wedge mounting adapter, 7F (fig. 9).

(*f*) Replace correction wedge shaft bracket, X143B (fig. 10), and coupling, X141D.

(*g*) Replace correction scale window adapter, X143D, with window and cell. If screws are of different lengths, use a short screw at the bottom to prevent scratching the scale. Set scale at 15.

(*h*) Replace end box adapter B618A (fig. 11), to marked position and replace the flat head locking screws in outside tube.

(*i*) Replace right penta prism mount, 13B.

(*j*) Replace end box, B619, to marked position. Secure with retaining ring, A1458.

(*k*) Replace eyepiece bracket, B129782A (fig. 10), to marked position. The auxiliary threaded rod, previously described, will be found necessary to hold and locate properly the eyepiece bracket plate.

(*l*) Replace range finder adapter, X142A.

(*m*) Check whether the image varies from or into the halving line by bringing an object into coincidence at the halving line and swinging the range finder so that the image traverses the field of view. The object should hold the same relative position across the field. If halving cannot be maintained, correct by temporarily loosening the three fillister head screws, BCGX3FF (fig. 11), which secure the penta prism mount and shifting the mount on its axis so as to tilt the prism.

(*n*) For final coincidence and halving adjustment, it may be necessary to rotate the end box window (wedge) until halving and coincidence are as nearly correct as possible. It may also be necessary after this adjustment to reposition the penta prism mount as in (*m*) above.

(*o*) Replace end box sleeve.

(*p*) Replace right end buffer assembly.

b. Mount.—(1) *Adjustments.*—The worm mechanisms are fitted with spring-actuated devices to eliminate backlash and should require no adjustment even after considerable use. Adjustments of the angle of site and azimuth micrometers are performed by the using arm and are described in connection with the operation of the instrument.

(2) *Disassembly.*—Disassembling of the mount may be required

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:06 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

for cleaning or repair purposes. Typical disassembling operations are described below. Refer to figures 13 and 14 for identification of parts.

(*a*) To remove the range finder support, 17F, drive out the pin, 0.063 by 0.4 inch, securing the clamping lever, X59B, and remove the lever. Remove the clamping screw, A36624, and special fillister head screw, A36622. Turn the support approximately 90° until free.

(*b*) To disassemble the catch, X166C, and plug, X166B, first remove the headless flat screw, BCUX1CC, and unscrew the plug, X166B, to release the pressure of the compression spring, X166A. Drive out the 0.125 by $1\frac{1}{16}$-inch pin, thereby releasing the catch, X166C, and plunger, 122A. Lubricate the parts with Royco 6A when reassembling.

(*c*) To remove the angle of site mechanism remove the four special screws, X118G, and lift the mechanism until free from the locating pins. To disassemble the angle of site mechanism remove the 0.242 by $\frac{1}{8}$-inch special flat headless screw and extract the plunger, X118D, and compression spring X118E. Loosen the headless flat screw, BCUX3MA, which secures the ball cap, X119B, remove the micrometer, X119F, and unscrew the ball cap. Remove the worm, X119C, and ball socket, X119D. Loosen the headless flat screw, BCUX3MB, which secures the retaining ring, X118F, and remove the retaining ring. Remove the special headless screw, X119G, and extract the level vial holder, B136697. When reassembling, adjust the retaining ring to a snug fit against the level vial holder, and adjust the ball cap and special flat headless screw for minimum shake in the worm.

(*d*) To remove the upper portion of the mount from the elevating worm wheel, 19M, remove the angle of site mechanism, remove the plugs, 19K, from both sides of the elevating worm housing, 17D, and remove the special headless screw, A36621. The elevating worm housing can then be lifted free. To disassemble the elevating worm parts remove the support, 17F, remove the 0.177 by 0.14 inch special headless screw and extract the compression spring, 19H, and plunger, 19G. Unscrew the plug, 19L, and extract the bearing, 19D. Remove the two special fillister head screws, A36623, which secure the bearing, 19E, and remove the worm and worm parts. When reassembling, adjust the special headless screw for sufficient spring pressure to eliminate shake in the worm parts.

(*e*) To disassemble the hinge joint, drive out the taper pin, B51K, securing the clamping screw handle, A33709, and remove the handle. The spindle, 21B, and support, 21C, may then be removed after

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:06 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

marking mating surfaces for identification on reassembly. The plug, 21A, need not be removed unless access to the head of the clamping screw, A33708, is required. Clean hinge surfaces before reassembling and lubricate with Royco 6A.

(*f*) To open the upper azimuth worm housing, 21F, loosen the cone point headless screw, BCUX2KE, in retainer, A39887, and unscrew the retainer. Operate the azimuth worm throw-out lever to disengage the azimuth worm and lift the upper portion of the mount clear of the lower portion. To remove the lower worm housing, 21G, remove the fillister head screw, BCGX4AU, which secures the notation strip and cover, A46529, and slide the cover out of its dovetail slot. Extract the spring, A45979, and plunger, A46526. Loosen the headless flat screw, BCUX3MB, in round nut, A46527, unscrew the round nut, and work the worm free. Remove the three fillister head screws, BCGX4CC, in retaining ring, A39888, and remove the retaining ring, which leaves the lower worm housing free for removal. To remove the azimuth worm, 22E, and its associated parts, drive out the taper pin, BFCX1B, in the azimuth worm knob, 22B, and remove the knob with its plate, 22D, and cylindrical spring, A1461. Remove the special fillister head screw, A36620, in throw-out lever, X67F, while holding the eccentric bushing, X67G, to prevent sudden release of the torsion spring, X67P. Remove the throw-out lever and withdraw the azimuth worm and eccentric bushing. On reassembling, clean all parts and lubricate the worms by packing with Royco 6A.

(*g*) Reassembling operations are performed in the reverse order of disassembly.

c. Adjusting lath.—If the index strips of the adjusting lath (fig. 16) are found to be out of adjustment, slightly loosen the screws holding the index plates and shift the plates in or out until correct coincidence is obtained. (This is performed by two persons, one operating the range finder and the other holding the adjusting lath, who by prearranged signals make the adjustment outlined.) Check this setting with four or five readings on the adjusting lath, then permanently secure the holding screws by applying shellac varnish under heads of screws, holding index plates securely. If in attempting to set the index plates it is found that the holes in the body of the adjusting lath have not been elongated to permit the movement of these plates, the holes may be elongated in the following manner:

(1) Remove eight screws holding end caps, X73C, and remove the caps. Remove eight screws, A35625, holding index plates, X73B, and remove the plates. Elongate eight holes in adjusting lath body,

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:06 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

C118B, for screws holding index plate so as to permit of lengthening or shortening space between the two index strips by 4 millimeters. Care should be taken in slotting to keep the width of the slots 0.112 inch in order to keep the index strips parallel. Reassemble index plates. Replace end caps, which should be filed slightly if the index plate screws prevent the caps from being reassembled in their original position.

(2) The tools required for this work are a screw driver (optical repair kit, No. 204) and a round file to fit a 0.112 inch hole.

SECTION IV

80-CM BASE RANGE FINDERS, M1914 AND M1914MI

10. Description.—The 80-cm base range finder, M1914 (or M1914MI), complete, consists of the range finder, tripods, types R and S, adjusting lath, type B, correction wedge key, camel's-hair brush, carrying strap, and carrying cases.

a. 80-cm base range finders, M1914 and M1914MI.—(1) These range finders are of two types, the M1914, serials 11 to 198, and the M1914MI, serials 199 and up. Those of the former type which bear serial numbers from 11 to 153 were originally equipped with an internal adjusting device which was intended to eliminate the need for an adjusting lath. This device was found unsatisfactory and is therefore being removed from all of the instruments in service as they are turned in for arsenal repair. With this device removed, the instruments become essentially the same as the remaining M1914 instruments, except that the adjusting prism housings remain as protuberances, as shown in figure 3, thereby forming a ready means for visual distinguishment. The M1914MI instruments incorporate several minor mechanical changes but are otherwise the same as the later M1914 instruments.

(2) The optical system of these range finders is shown in figure 22. Mechanical details are shown in figures 23 to 32, inclusive. The internal adjusting device is not shown.

(3) The eyepiece is focused by rotation of the diopter scale, X174C (fig. 26). An object viewed through the eyepiece appears erect in a circular field, with a horizontal band across its center in which is seen the inverted image of the object ranged on. The lower edge

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:06 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

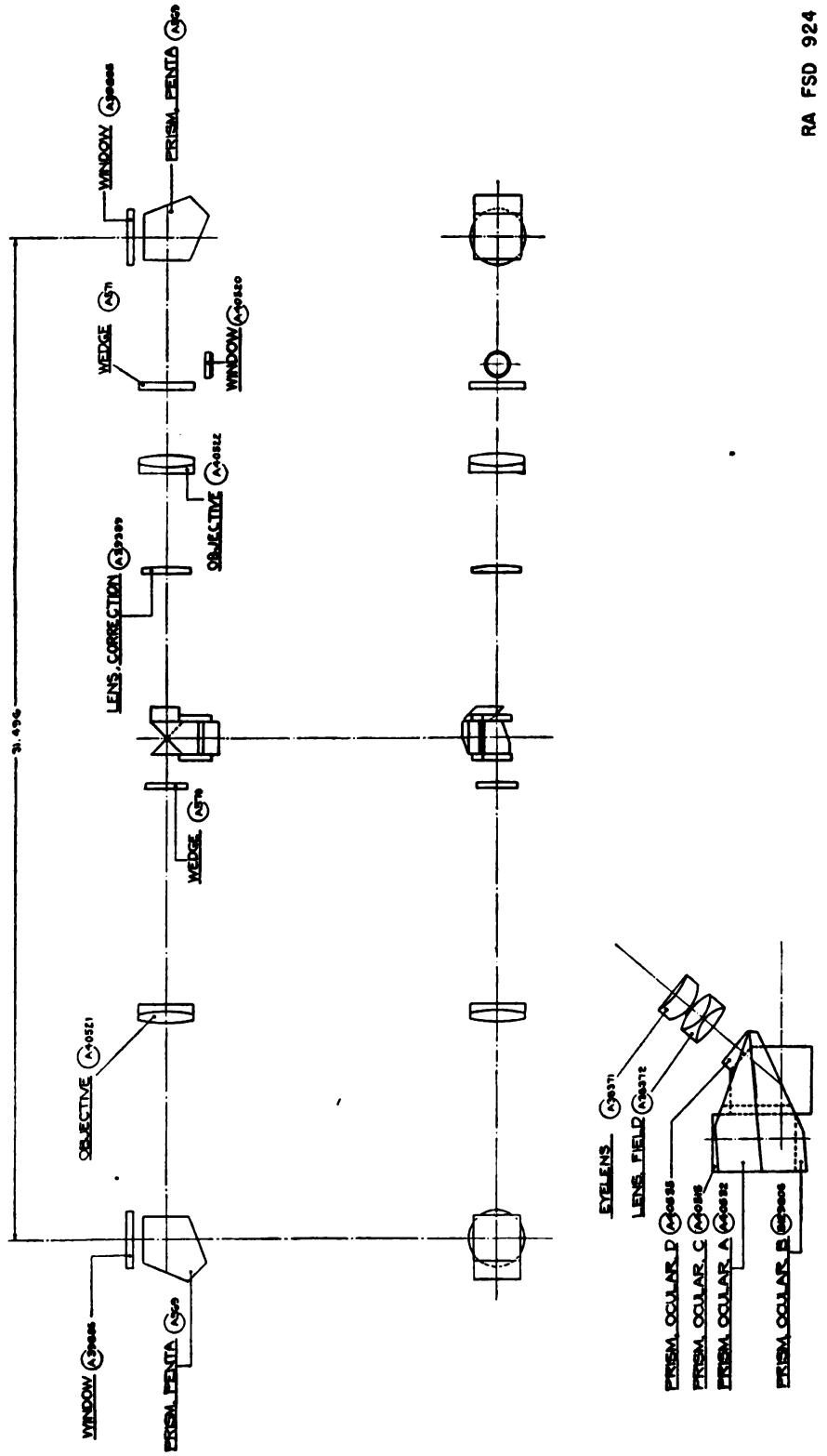


FIGURE 22.—Optical system for 80-cm base range finder, M1914MI.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:10 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

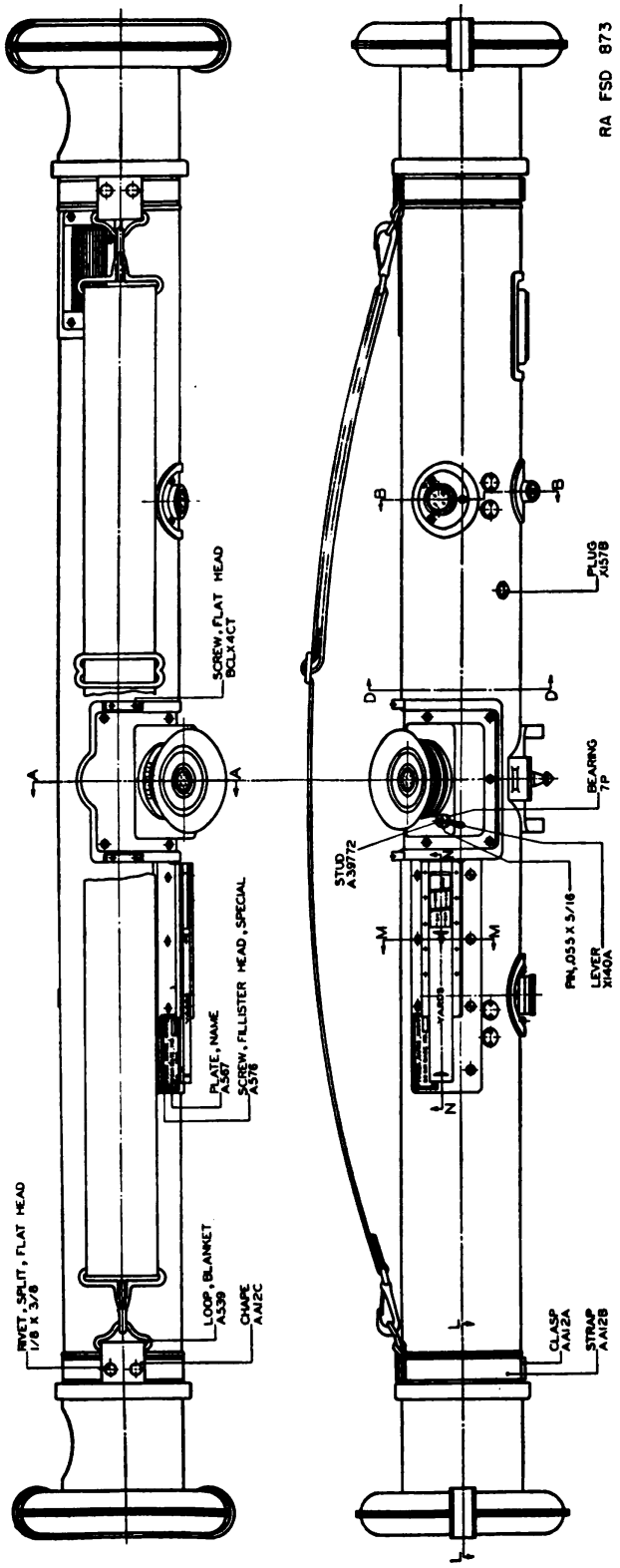
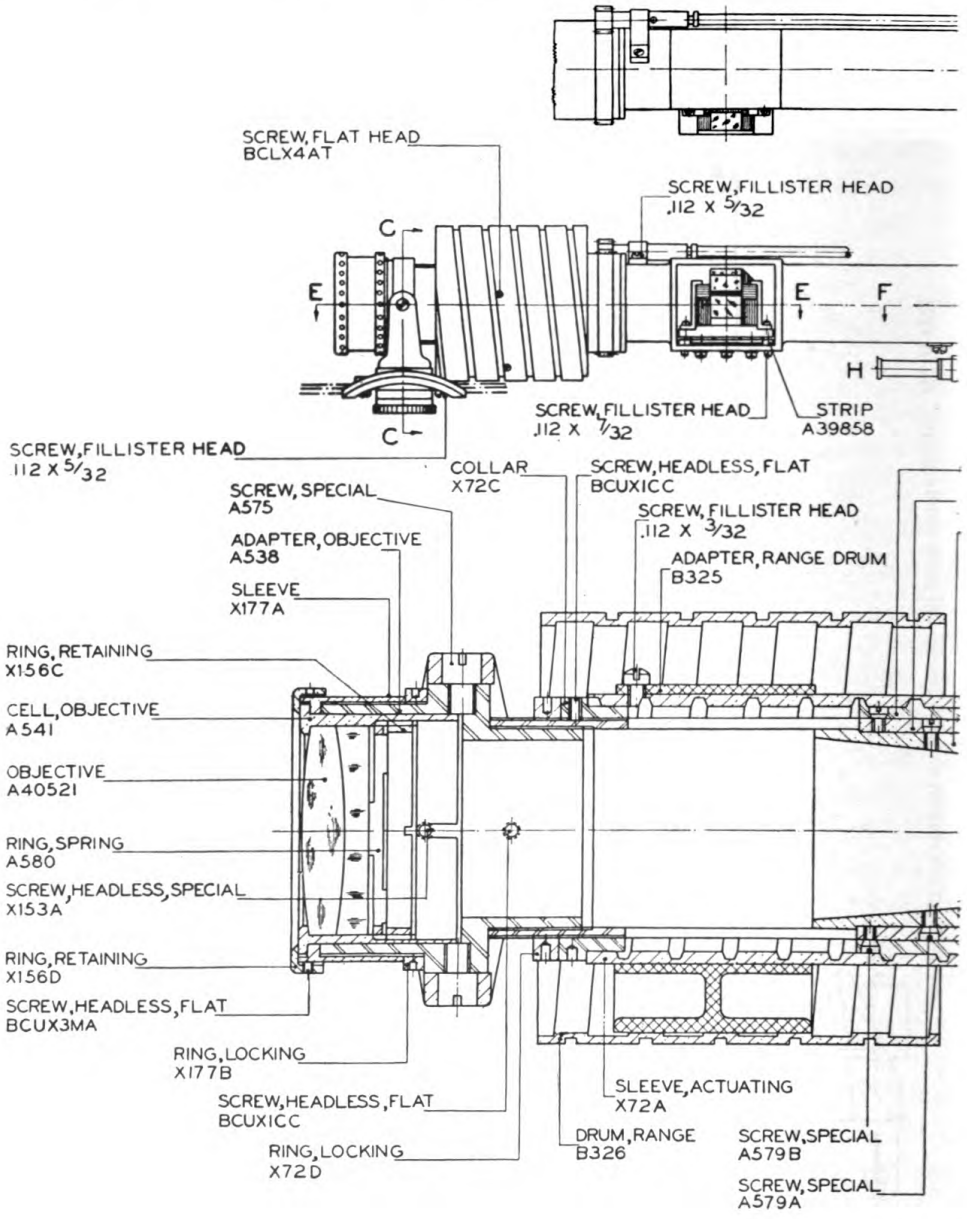


FIGURE 23.—80-cm base range finder, M1914—assembled views.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:10 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

of the horizontal band is the halving line. The ray filter lever, X140A (fig. 23), near the eyepiece controls a ray filter holder containing an amber ray filter, A40518 (fig. 26), and a smoked ray



SECTION E-E

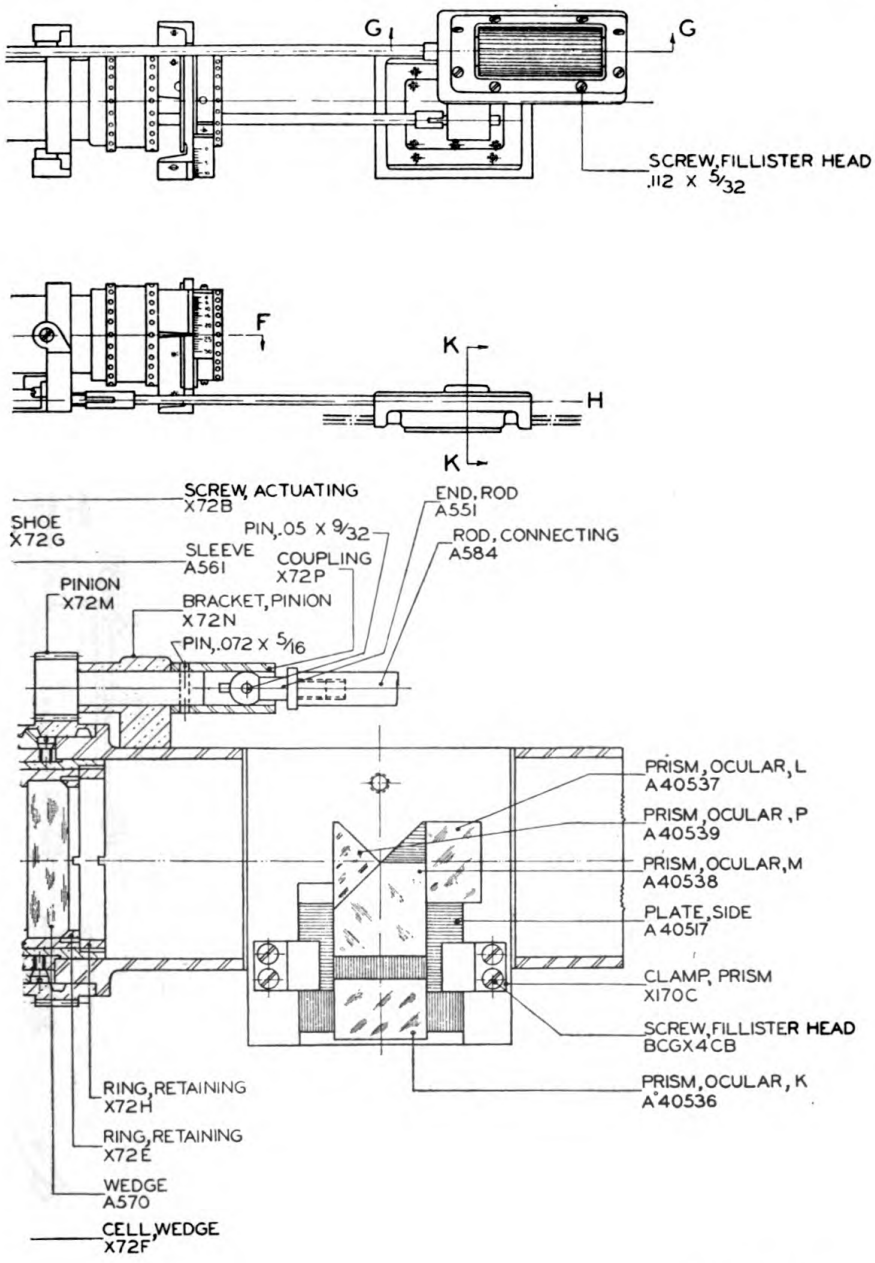
FIGURE 24.—80-cm base range

filter, A40519. The amber ray filter is used to moderate exceptionally bright daylight or the reflection of the sun over water; the smoked ray filter is used for observing into the direct rays of a search-

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:10 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

light. The open sights, A578, facilitate training of the range finder on the desired object.

(4) The central optical parts are mounted in a separate optical



finder, M1914—sectioned view E–E.

tube, 7B (M1914, fig. 25), C44782 (M1914MI, fig. 30), within the outside tube, D25775 (M1914, fig. 26), 14B (M1914MI, fig. 31). This optical tube is supported at the left end in the gimbal joint fork,

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:10 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

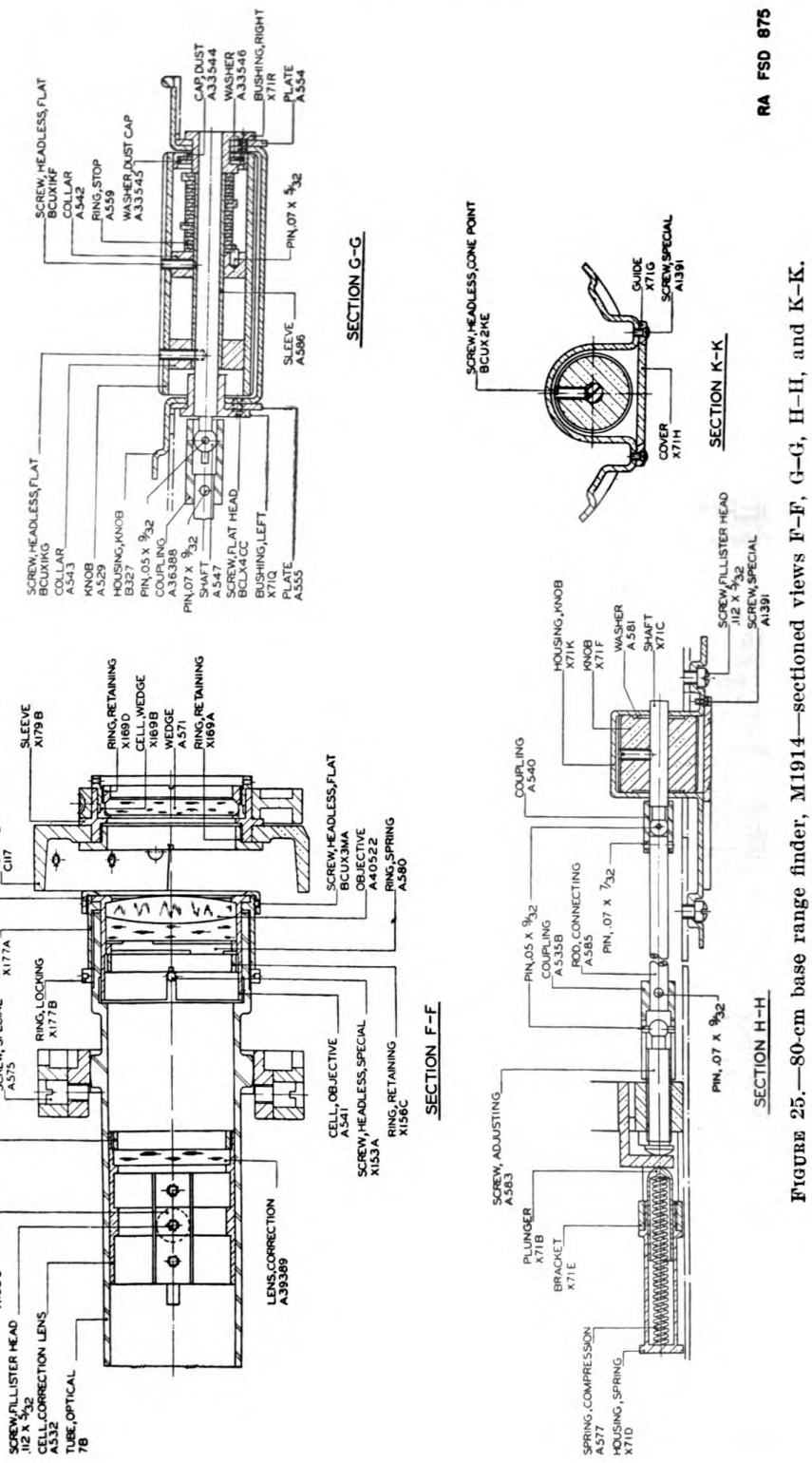


FIGURE 25.—80-cm base range finder, M1914—sectioned views F–F, G–G, H–H, and K–K.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:11 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

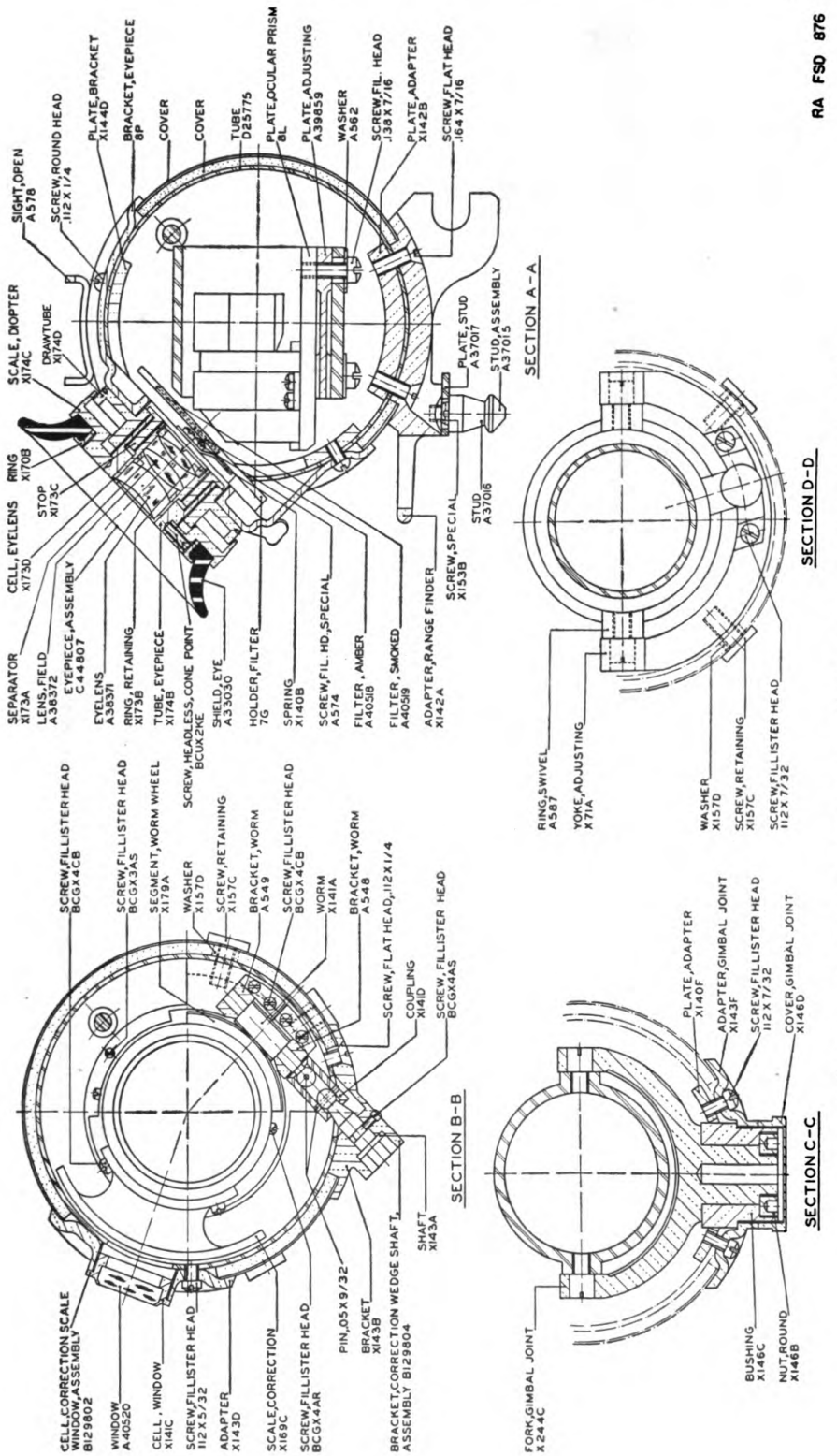


FIGURE 26.—80-cm base range finder, M1914—sectioned views A-A to D-D.

Generated on 2017-02-23 18:11 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

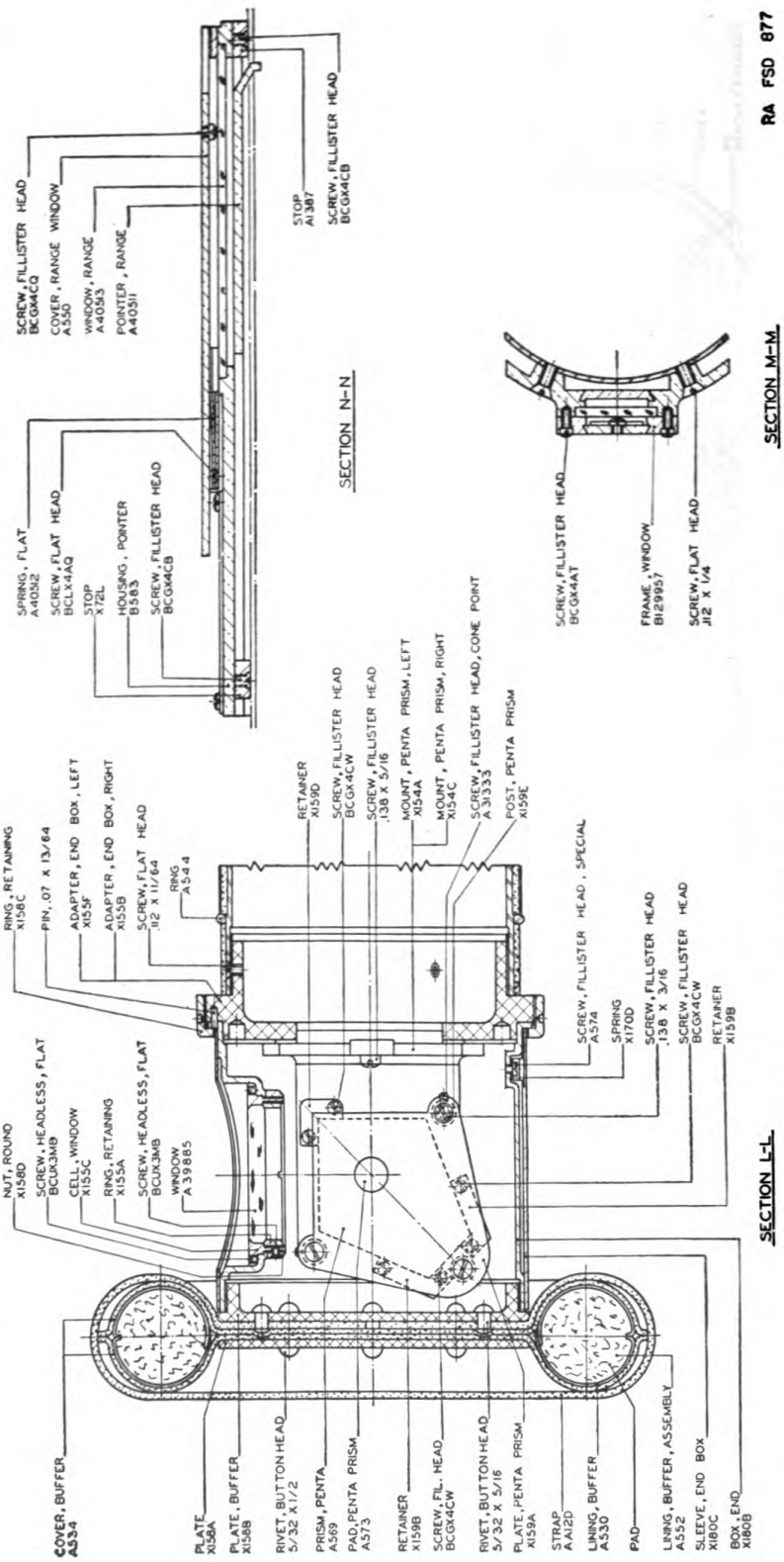


FIGURE 27.—80-cm base range finder, M1914—sectioned views L-L to N-N.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:11 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

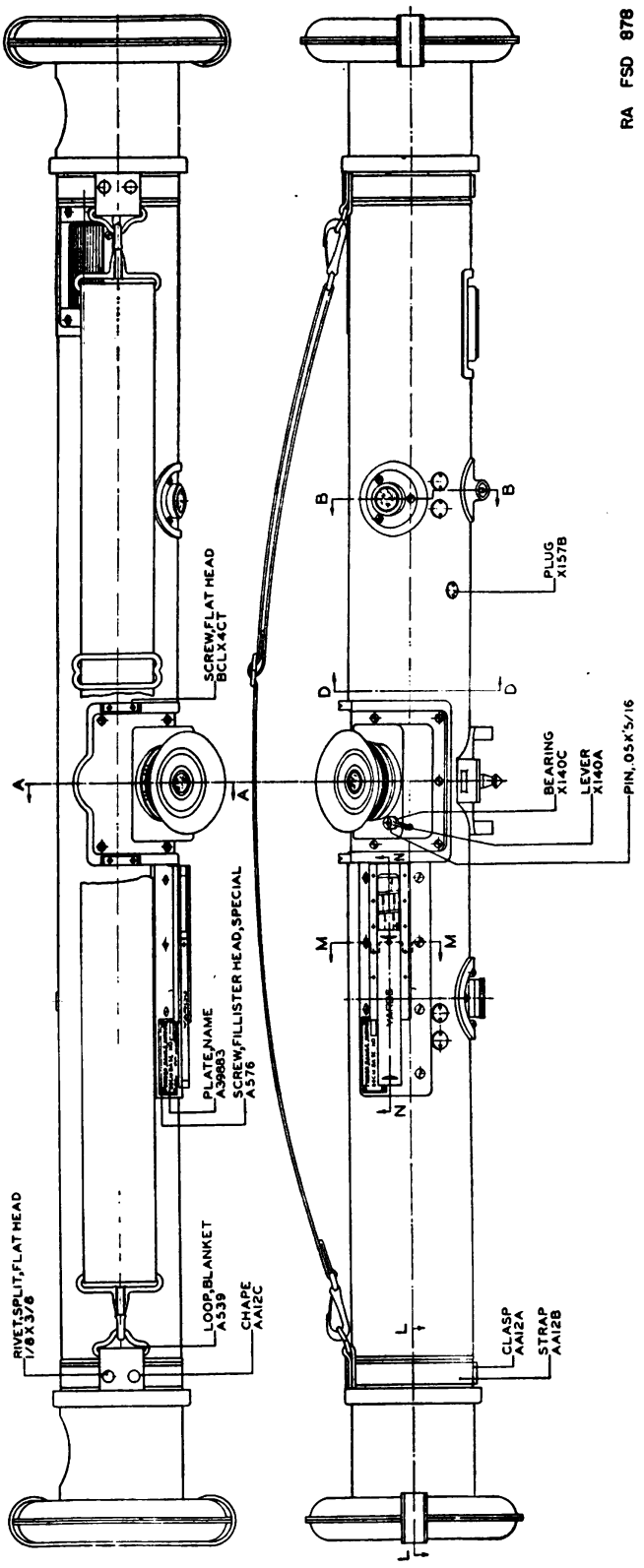
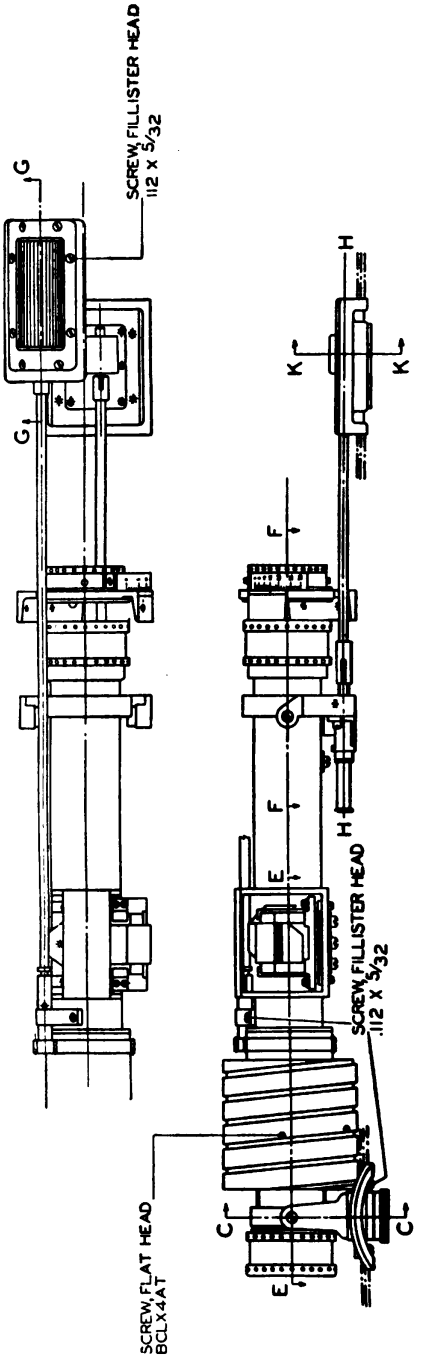


FIGURE 28.—80-cm base range finder, M1914MI—assembled views.

Generated on 2017-02-23 18:11 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



Generated on 2017-02-23 18:11 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

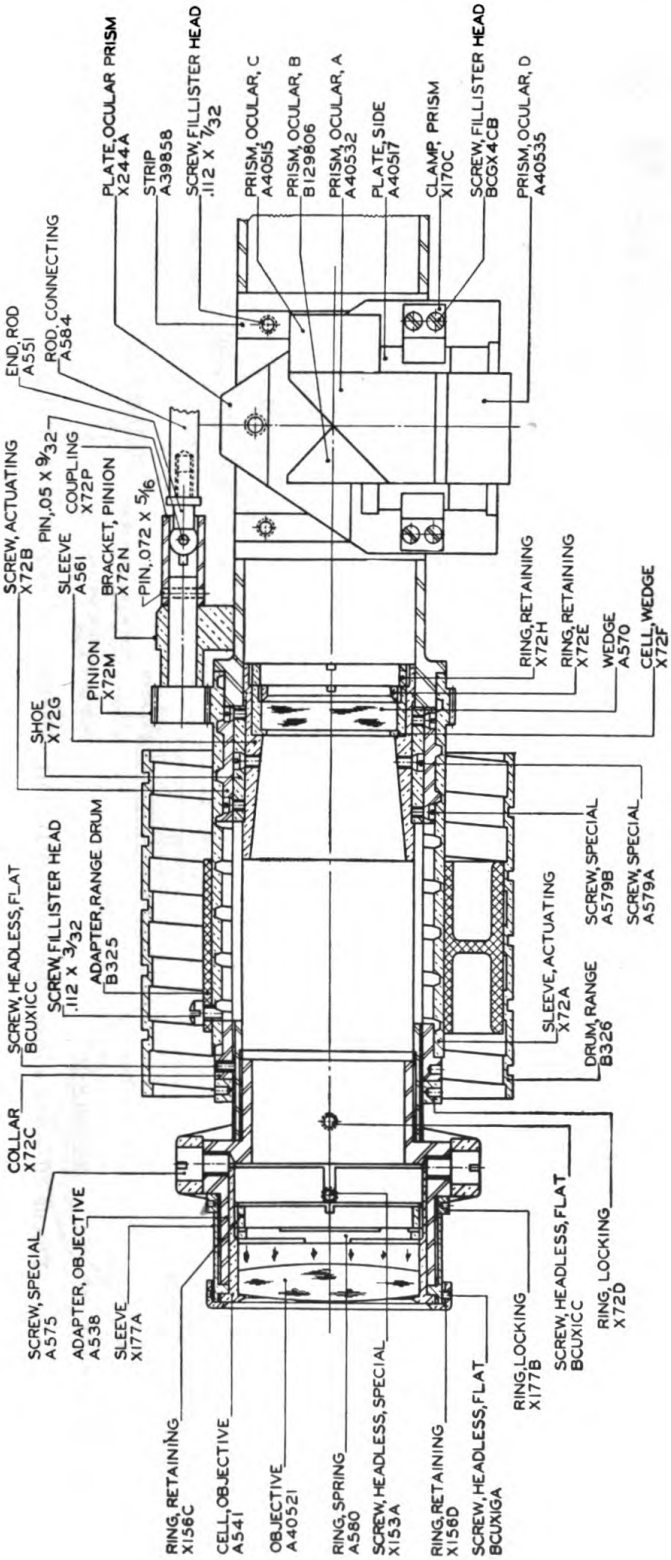


FIGURE 29.—80-cm base range finder, M1914MI—sectioned view E–E.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:11 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

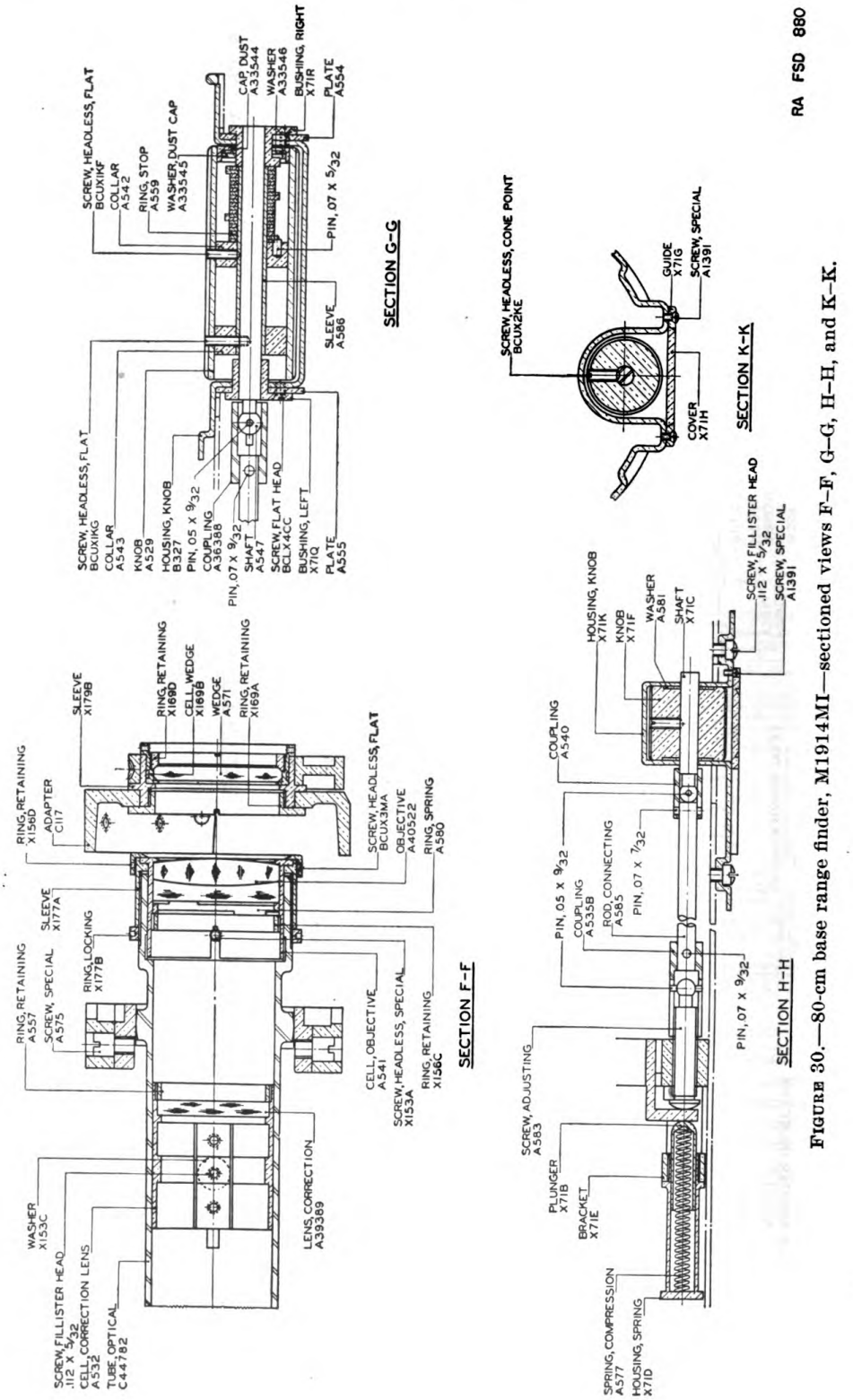


FIGURE 30.—80-cm base range finder, M1914MI—sectioned views F–F, G–G, H–H, and K–K.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:11 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

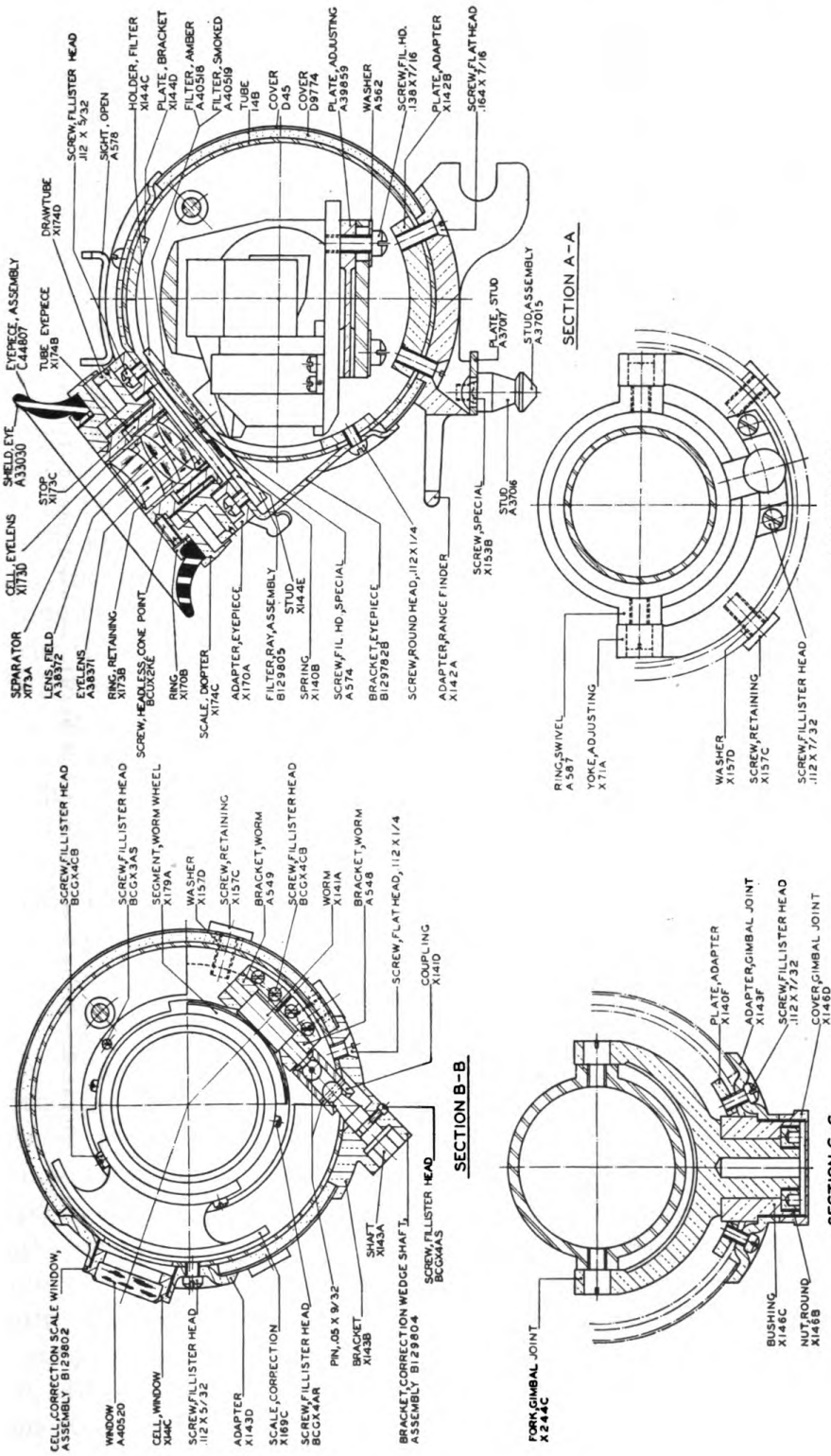


FIGURE 31.—80-cm base range finder, M1914MI—sectioned views A–A to D–D.

Generated on 2017-02-23 18:11 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

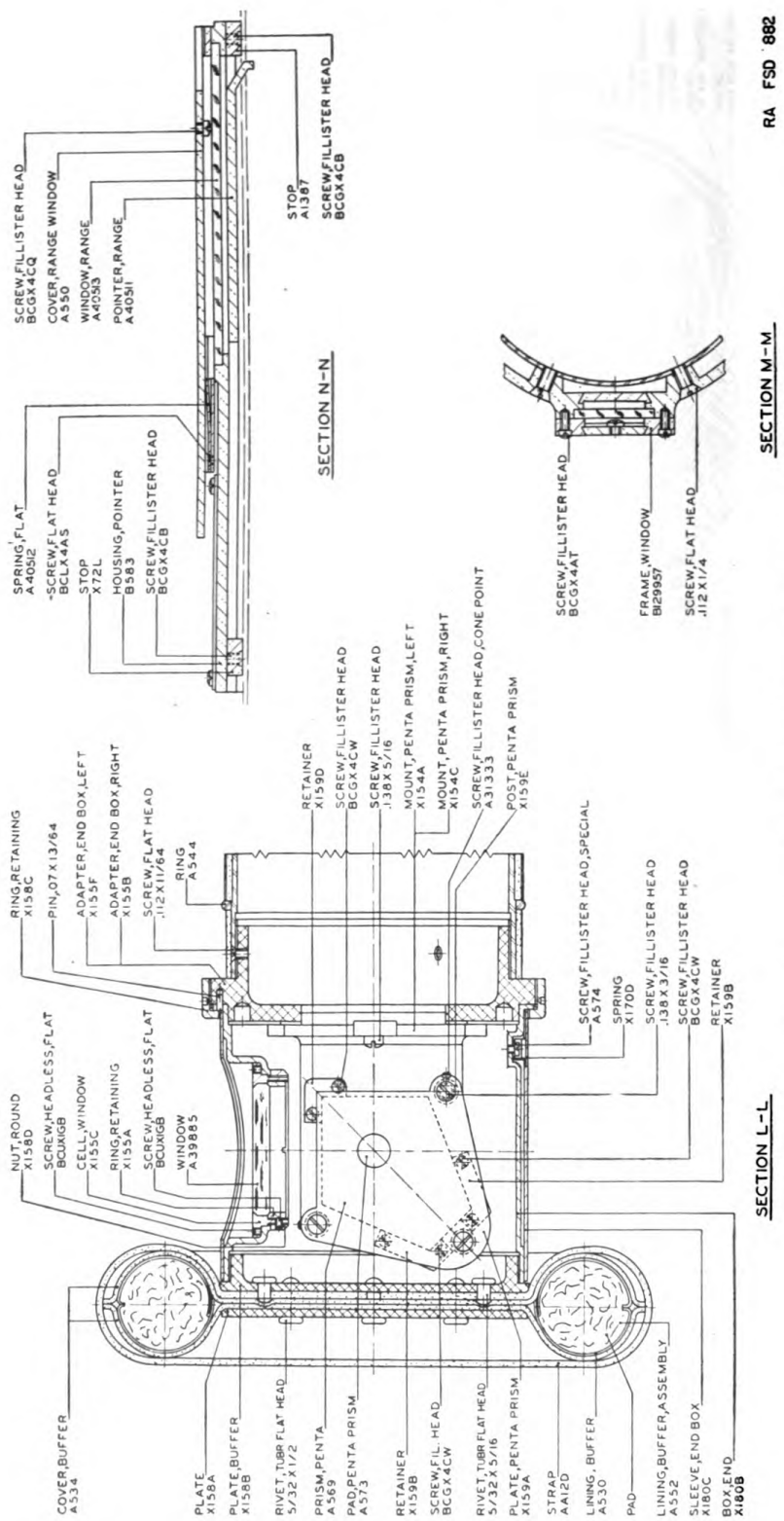


FIGURE 32.—80-cm base range finder, M1914MI—sectioned views L–L to N–N.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:12 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

X244C (figs. 26 and 31), and the right end is carried in the halving adjusting swivel ring, A587, which is actuated by the halving adjusting knob, X71F (figs. 25 and 30), for adjustment in height. The appearance of the optical tube assembly and the method of support are shown in the upper views of figures 24 and 29.

(5) The range drum knob, A529 (figs. 25 and 30), simultaneously operates the measuring wedge, A570 (figs. 24 and 29), and range drum, B326. The range drum is spirally graduated in yards and is read against the index line of the range pointer, A40511 (figs. 27 and 32).

(6) The correction wedge shaft, X143A (figs. 26 and 31), operates the correction wedge, A571 (figs. 25 and 30), and the correction wedge scale, X169C (figs. 26 and 31). The graduations of this scale are in arbitrary units. A correction wedge key is supplied with the instrument to fit the squared end of the shaft.

(7) The end box assemblies at each end of the outside tube contain the penta prisms, A569 (figs. 27 and 32), and the end box windows, A39885. The end box sleeves, X180C, can be rotated to cover the window openings and thereby guard against the entrance of dirt or dust. The buffer assemblies are provided as a protection against minor shocks.

(8) The range finder adapter, X142A (figs. 26 and 31), assembled to the outside tube below the eyepiece is the means for attaching the range finder to the support on the upper portion of the tripod, type S.

(9) The optical characteristics of the range finder are as follows:

Power	10X.
Field of view	4°30′.
Diameter of exit pupil	0.09 inch.

b. Tripods, types R and S.—The tripod, type S, is a short tripod with legs that can be folded together so as to fit into the head of the tripod, type R, as shown in figure 33, or spread to form an independent tripod structure, as in figure 35. The head of the tripod, type S, contains suitable mechanisms for traversing, lateral leveling, and elevating of the range finder so that the tripod, in effect, functions as a mount for the range finder. The tripod, type R, shown in figure 34, is a larger tripod which is designed specifically for use in conjunction with the tripod, type S.

c. Adjusting lath, type B.—The adjusting lath, type B (fig. 36), consists of a metal body, C118A, carrying two accurately spaced index strips, X73A, the distance between which is equal to the base

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:25 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

of the range finder. Each adjusting lath is individually adjusted and bears the same serial number as the range finder. The sight assembly is removable to permit placing the adjusting lath in the carrying case.

d. Carrying cases.—The carrying case for range finder and tripod is shown in figure 37. The tripod, type R, fits into the pocket on the

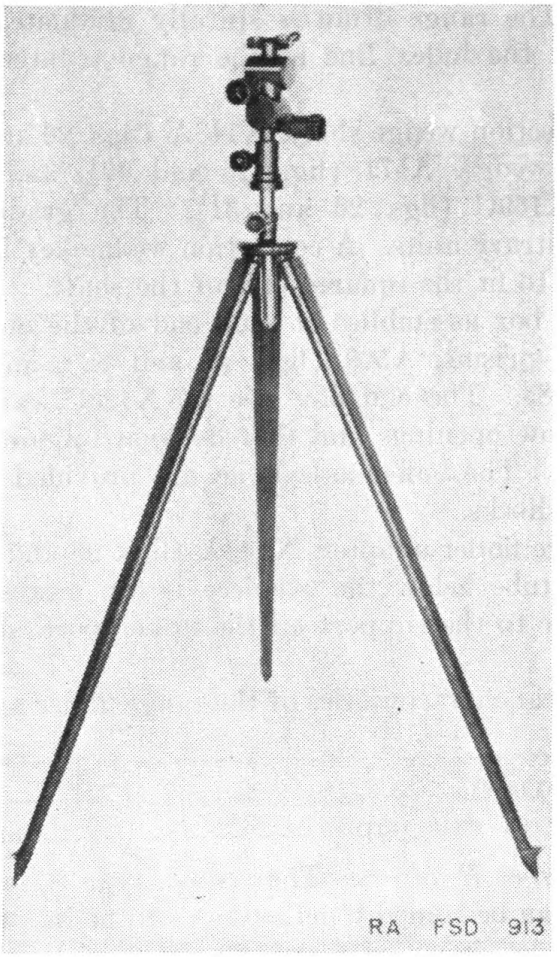


FIGURE 33.—Tripods, types R and S.

side of the case and is secured by means of the hood and fastening strap. The lid of the carrying case is formed with a tool pan which is covered by the lid cap and which is used for carrying small items of equipment, such as the correction wedge key, camel's-hair brush, etc. Separate canvas carrying cases are furnished for the tripod, type S, and the adjusting lath, type B.

11. Operation.—*a. Range measurement.*—To measure the range of an object, select a clearly defined part perpendicular, if possible,

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:25 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

to the halving line. Move the instrument in azimuth and elevation as required to bring the part to the center of the field of view. When first observed, the images will ordinarily not be in coincidence (fig.

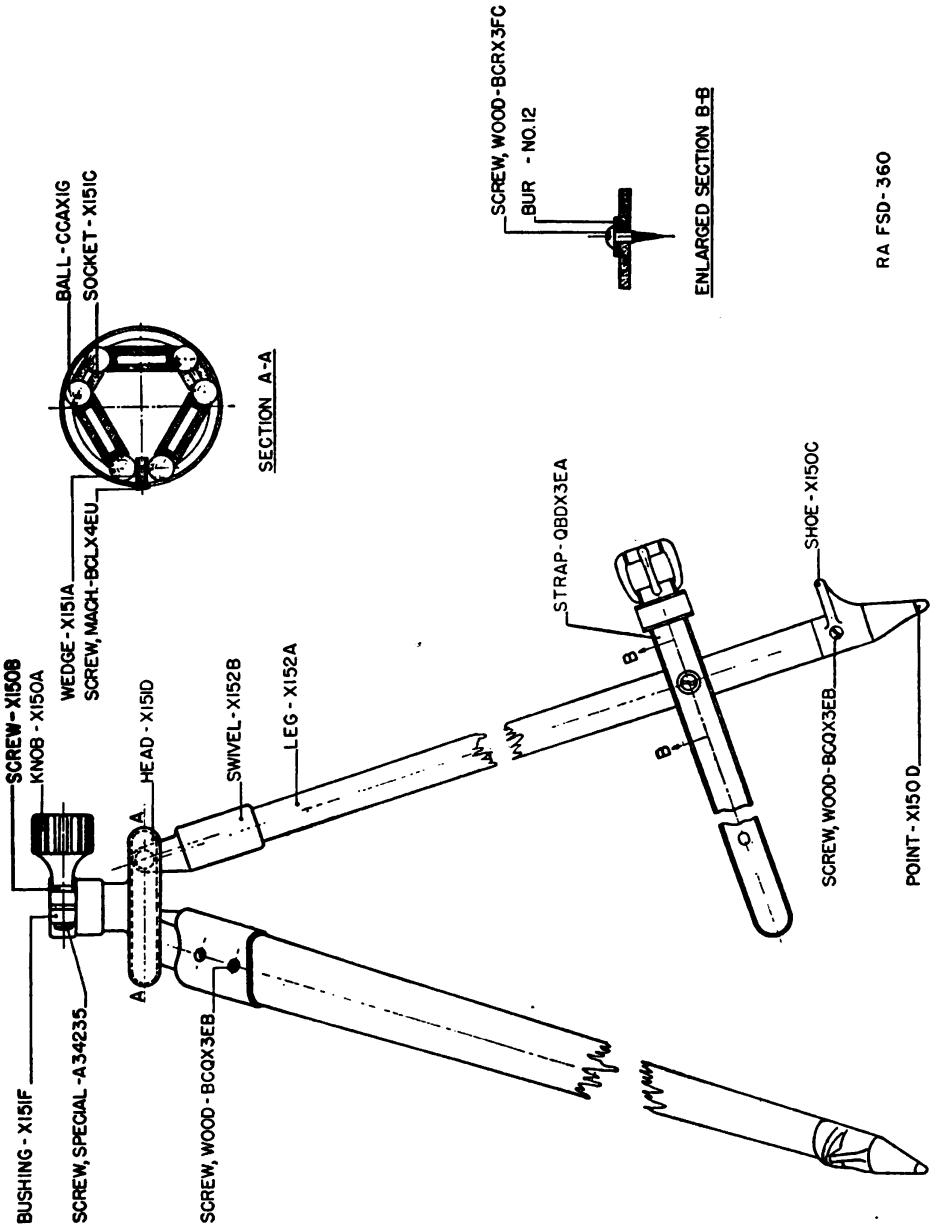


FIGURE 34.—Tripod, type R—assembled and sectioned views.

38①). Turn the range drum knob until the images of the point selected appear in coincidence (fig. 38②). Read the range, in yards, on the range drum, opposite the sliding range pointer.

b. Field adjustment.—(1) *Halving adjustment.*—Incorrect adjustment of the halving line is indicated by the failure of the correspond-

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:25 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

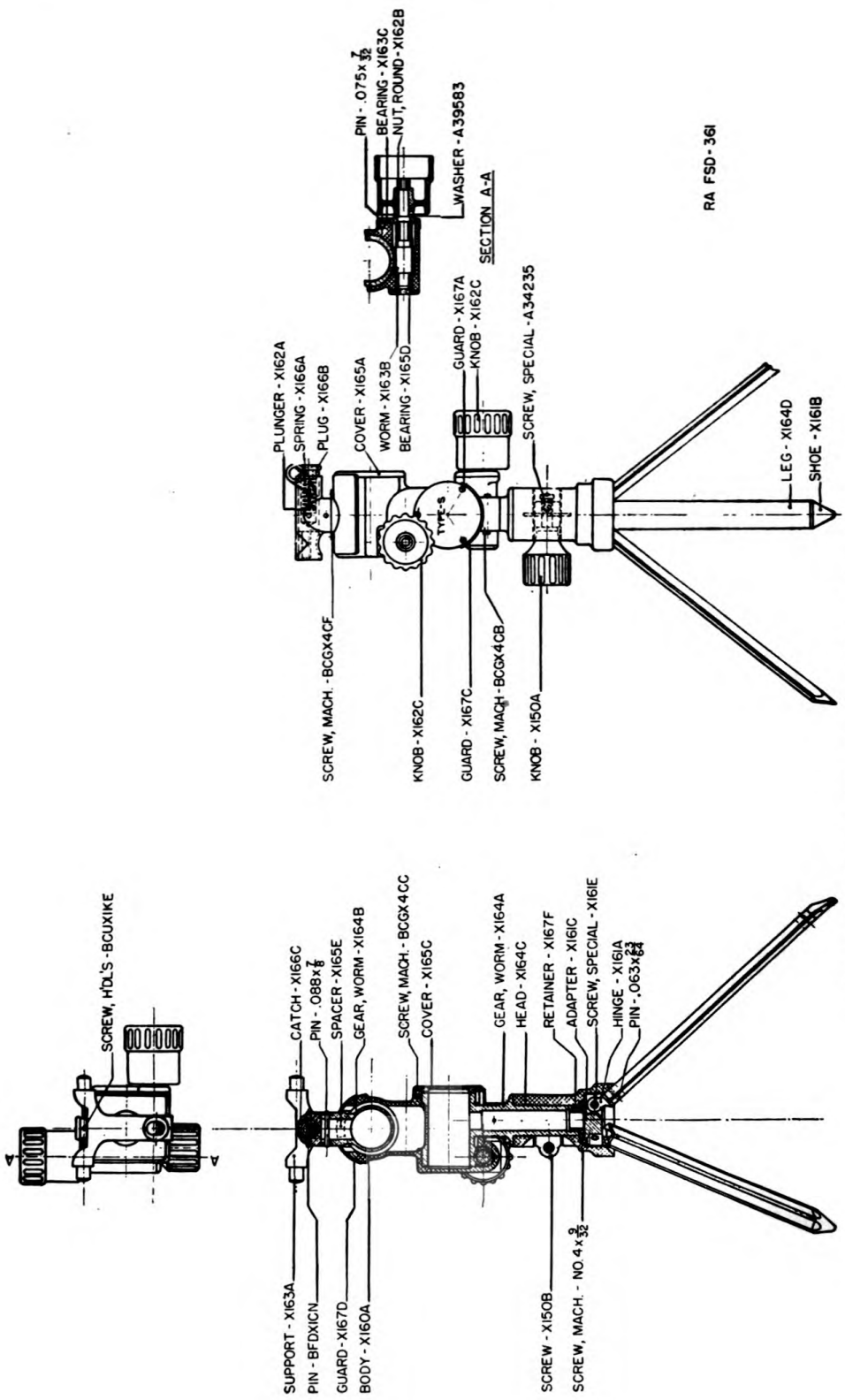


FIGURE 35.—Tripod, type S—assembled and sectioned views.

Generated on 2017-02-23 18:26 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

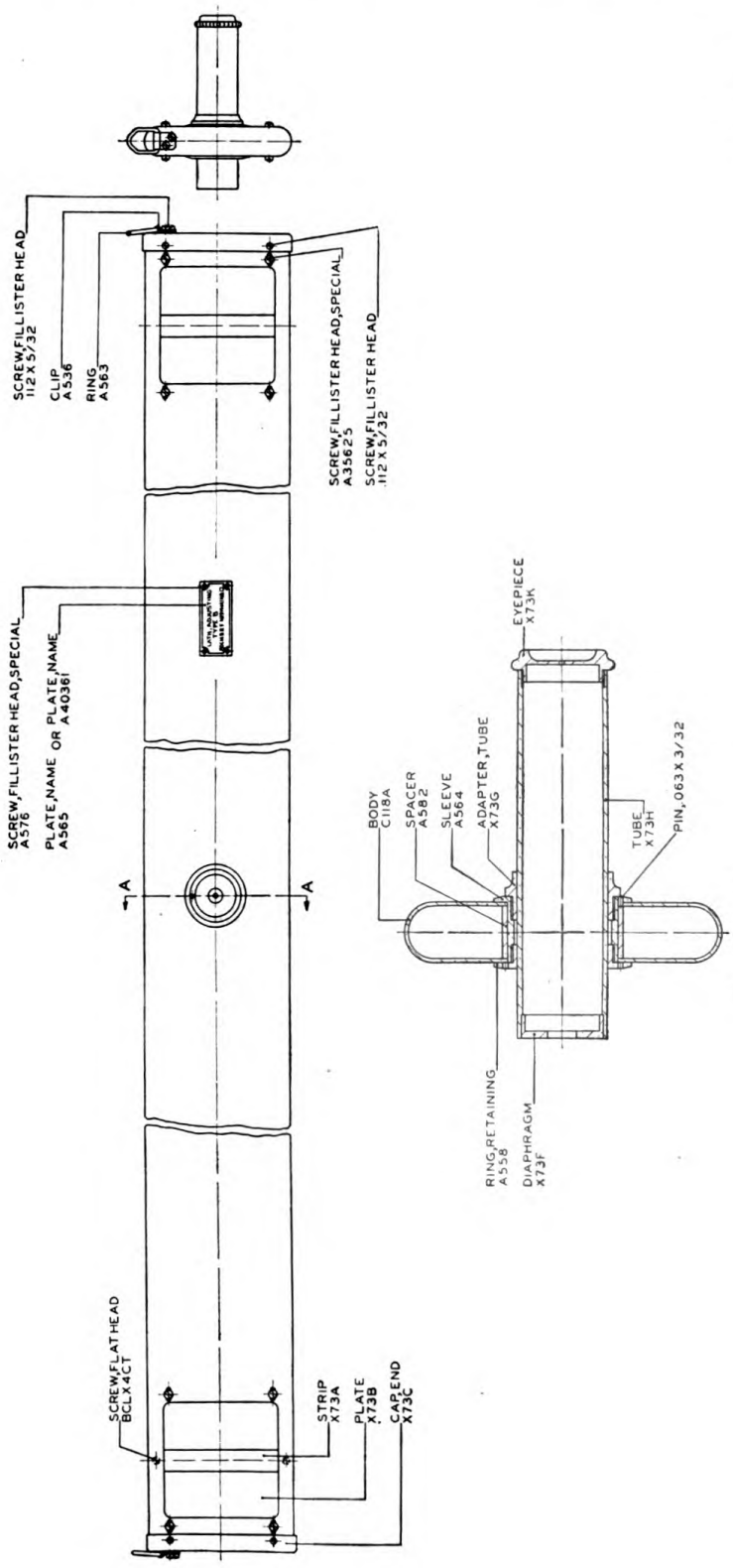


FIGURE 36.—Adjusting lath, type B—assembled and sectioned views.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:26 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

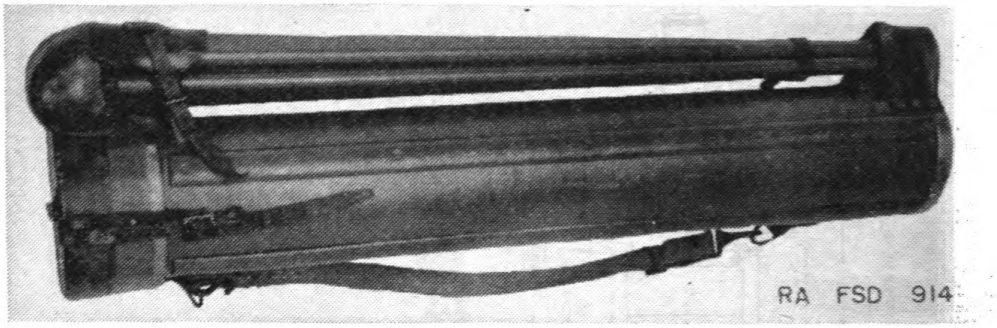


FIGURE 37.—Carrying case for 80-cm base range finders, M1914, M1914MI, M1917, M1917MI, and tripods.

ing points on the inverted and erect images to fall on the halving line (fig. 39). To correct the halving, slide back the cover exposing the halving adjusting knob and rotate the knob until the corresponding point of each image touches the halving line (as in fig. 38). A sharply defined point at least 400 yards away must be used for this

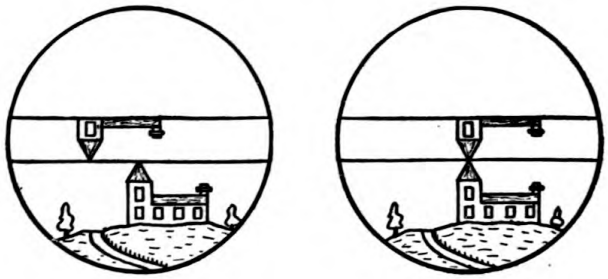


FIGURE 38.—Fields of view.

FIGURE 39.—Incorrect halving adjustment.

adjustment. Return the cover to its original position when the adjustment is completed.

(2) *Range indications.*—(*a*) To test the instrument using a finite range, select a sharply defined object at a distance of 400 yards or more, the range of which is accurately known, and bring the object

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:26 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

into coincidence in the center of the field of view (fig. 38②). If the range adjustment is correct, the known range should be indicated.

(*b*) To test the instrument by the infinity method, prepare the adjusting lath by inserting the sight assembly (carried in the pocket of the carrying case). Place the adjusting lath in a horizontal position at least 125 yards from the instrument. Use the sight on the lath to insure perpendicularity to the line of sight. Set the range drum to indicate infinite range (∞). If the images appear alined as in figure 40② the adjustment is correct; misalinement, such as is shown in figure 40①, indicates the necessity for adjustment.

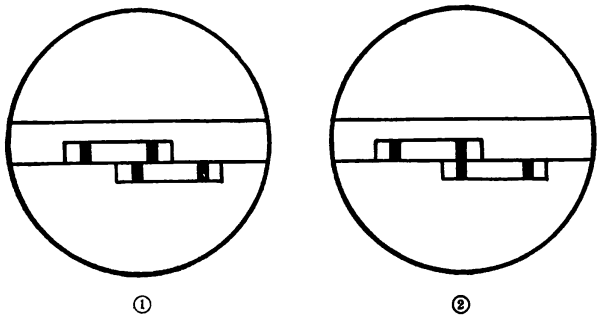


FIGURE 40.—Views when using adjusting lath.

(*c*) To adjust the instrument in range, set the range at the known range or at infinity, depending on the method of test employed, and bring the images into correct relation using the correction wedge key (accessory) to turn the correction wedge shaft. Note the indication on the correction wedge scale, repeat several times, and set the scale to the average of the readings.

(*d*) When the adjusting lath is used, it must be the one belonging with the particular range finder. The same serial number is provided on both.

c. Accuracy of measurement.—The error which a practiced observer may make under the most favorable conditions is shown in the following table:

Range in yards	*Average error, yards*
400	3
1,000	6
2,000	25
4,000	100

12. Inspection.—Inspection is for the purpose of determining the condition of the instrument, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:27 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

a. Range finder.

Parts to be inspected	*Points to be observed*
(1) Exposed mechanical parts.	(1) Observe general appearance, smoothness of operation of knobs, end box sleeves, ray filter lever, etc., and bent or missing parts.
(2) Open sight.	(2) Line of sight should intersect optical line of sight within a tolerance of approximately 10 mils.
(3) Eyeshield.	(3) The eyeshield requires replacement if torn or otherwise damaged.
(4) Optical system.	(4) Note if checks or frost patterns appear in the field of view. Such defects are evidence of loosening of the balsam used in cementing prisms and lenses and, if severe, require the return of the instrument to an arsenal for overhaul.
(5) Diopter scale.	(5) Using the collimating telescope (optical repair kit, No. 90), focus the eyepiece for sharpness and clearness of definition of the halving line and of both images. The reading of the diopter scale at optimum focus should be approximately zero. If not, diopter scale should be reset.
(6) Correction lens.	(6) Bring an object into coincidence in the center of the field of view, then turn the range finder in azimuth to bring the image to the edges of the field. If the image does not remain in coincidence, the correction lens is out of adjustment.
(7) Gimbal joint.	(7) Rotate halving adjusting knob to its limits. At each limit operate range drum knob to cover entire scale of range drum. Note if drum rubs on inside of outer tube, which indicates gimbal joint out of adjustment.
(8) Halving adjustment.	(8) Adjust the range finder to correct halving. If proper adjustment

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:26 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Parts to be inspected	*Points to be observed*
	cannot be obtained, or if halving adjusting knob is very near its limit, halving adjustment mechanism requires overhaul.
(9) Correction wedge.	(9) Adjust instrument for range, preferably using a datum point of known range. If proper adjustment cannot be obtained, or if correction wedge scale indicates too far from center, the correction wedge mechanism is out of adjustment.
(10) Prisms.	(10) Check a sharply defined object for halving at each edge and at the center of the halving line. If halving cannot be maintained without readjustment, it is an indication that the ocular or penta prisms have shifted.
b. Adjusting lath.	
(1) Exposed mechanical parts.	(1) Note loose or missing screws, end caps, straps, and strap rings. Test the sight tube threads by screwing the sight tube in place.
(2) Name plate.	(2) Serial number of adjusting lath should be the same as range finder.
(3) Straightness.	(3) If bent so that the space between index lines is shortened, the lath should be corrected.
(4) Alinement.	(4) Set up the range finder on its tripod and mount or on V-blocks (optical repair kit, No. 75). Place the adjusting lath at a distance of 125 yards in front of the range finder and parallel to it so that the range finder appears in the center of the field of view when sighting through the peep sight of the lath. Check the range adjustment against a fixed reference target at medium distance (500 to 2,000 yards), the range of

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:26 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Parts to be inspected	*Points to be observed*
	which is accurately known. Make four or five check readings and then set range drum to read infinity. Direct the range finder on the adjusting lath. If the right index strip of the inverted image of the adjusting lath is in exact coincidence with the left index strip of the erect image, the index strips are properly spaced.

13. Maintenance and repair.—Repairs which necessitate disassembling and assembling operations are limited to those which do not affect the optical alinement of the instrument. Repairs involving realinement, removal, or replacement of optical parts, or other repairs which cannot be made with the facilities available, will require that the instrument be turned in to the base shop.

a. Range finder.—(1) *Eyeshield.*—The eyeshield is of soft rubber, molded to fit between the grooves of the diopter scale and eyeshield ring. It can be removed by unscrewing the eyeshield ring. Be careful not to damage the threads in replacing. Use lukewarm water to clean the eyeshield. Replace eyeshield if torn or otherwise damaged.

(2) *Diopter scale.*—The diopter scale can be removed or reset by backing off the three headless cone point screws which are exposed after disassembling the eyeshield and eyeshield ring. These screws fit into a V-shaped groove in the eyepiece tube and if backed off sufficiently allow the scale to be lifted free. When replacing the diopter scale, focus the eyepiece to present a sharp image when viewed through the collimating telescope (optical repair kit, No. 90), set the diopter scale to indicate zero at this focus, and secure in position. Make certain that the headless screws seat below the surface before replacing the eyeshield and eyeshield ring.

(3) *Open sights.*—If either open sight is out of alinement and cannot be bent back into alinement, replace with a new sight.

(4) *Dismounting.*—Dismounting is accomplished through the right-hand end of the range finder. The procedure outlined below must be carefully followed in order to maintain the alinement of the optical parts.

(*a*) Remove right end buffer assembly (right-hand thread).

(*b*) Remove end box sleeve.

(*c*) Remove end box retaining ring, X158C (figs. 27 and 32).

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:27 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

(*d*) Remove end box, X180B. Mark position. The end box is secured to its adapter by three drive pins.

(*e*) Remove right penta prism mount, X154C, by removing the three fillister head screws.

(*f*) Remove end box adapter, X155B, secured by three flat head screws under strap and threaded in place. Mark position.

(*g*) Remove correction scale window adapter, X143D (figs. 26 and 31), with window and cell.

(*h*) Remove correction wedge shaft bracket, X143B, and coupling, X141D.

(*i*) Remove halving adjusting knob housing, X71K (figs. 25 and 30), and connecting rod, A585.

(*j*) Remove range drum knob housing, B327, and connecting rod, A585.

(*k*) Remove two external screws securing correction wedge mounting adapter, C117, and pull adapter out through end of tube, using drill rod hooks.

(*l*) Remove range pointer housing, B583 (figs. 27 and 32) (eight screws, one under name plate).

(*m*) Remove eyepiece bracket, B129782A (fig. 31), secured by seven screws. Before removing the last screw, hold the bracket plate by means of wires hooked through empty screw holes to prevent the plate from falling into the interior and possibly damaging the ocular prism assembly. Mark locating lines around bracket to insure proper positioning when reassembling.

(*n*) Remove screws holding gimbal joint adapter, X143F (figs. 26 and 31). Open gimbal joint cover, X146D, and remove round nut, X146B.

(*o*) Remove two external retaining screws, X157C, which secure halving adjusting yoke, X71A.

(*p*) Remove range finder adapter, X142A.

(*q*) Withdraw optical tube assembly from outside tube through right side, tipping gimbal joint fork to allow free passage. Adapter plates are removed at the same time.

(*r*) Place optical tube in V-blocks properly set.

(*s*) Extreme care must be taken during these operations to prevent entrance of foreign matter to the interior of the instrument.

(5) *Reassembling.*—In assembling, all screws will be shellacked under head and all outside joints will be sealed. Screws which will be disturbed in adjusting will not be shellacked until all adjustments have been made.

(*a*) Place adapter plates on optical tube in their proper positions.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:27 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Slide optical tube assembly into outside tube. Exercise care that ocular prism does not bear on the tube to avoid possible chipping of the ocular prism.

(*b*) Replace gimbal joint adapter, X143F, using threaded drill rod to pick up and maneuver the adapter plate. Tighten adapter securely. Do not tighten round nut, X146B, until halving adjuster has been coupled. The round nut should then be firmly tightened.

(*c*) Replace two external retaining screws, X157C, which secure halving adjusting yoke, X71A. Couple halving adjuster and set it midway in its movement. Secure halving adjusting knob housing, X71K (figs. 25 and 30). If adapter screws are of different lengths, use a short screw over the coupling to allow free movement.

(*d*) Couple range drum knob. Connect so that end of movement is properly limited by the stop rings, A559, in the range drum knob. Fasten the range drum knob housing, B327.

(*e*) Replace range pointer housing, B583 (figs. 27 and 32).

(*f*) Replace correction wedge mounting adapter, C117 (figs. 25 and 30).

(*g*) Replace correction wedge shaft bracket, X143B (figs. 26 and 31), and coupling, X141D.

(*h*) Replace correction scale window adapter, X143D, with window and cell. If screws are of different lengths, use a short screw at the bottom to prevent scratching the scale. Set scale at 15.

(*i*) Replace end box adapter, X155B (figs. 27 and 32), to marked position and replace the flat head locking screws in outside tube.

(*j*) Replace right penta prism mount, X154C.

(*k*) Replace end box, X180B, to marked position. Secure with retaining ring, X158C.

(*l*) Replace eyepiece bracket, B129782B (fig. 31), to marked position. An auxiliary threaded rod will be found necessary to hold and locate properly the eyepiece bracket plate.

(*m*) Replace range finder adapter, X142A (figs. 26 and 31).

(*n*) Check whether the image varies from or into the halving line by bringing an object into coincidence at the halving line and swinging the range finder so that the image traverses the field of view. The object should hold the same relative position across the field. If halving cannot be maintained, correct by temporarily loosening the three fillister head screws which secure the penta prism mount and shifting the mount slightly as required. The left penta prism mount should not require adjustment as it has not been removed.

(*o*) For final coincidence and halving adjustment, it may be

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:27 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

necessary to rotate the end box window (wedge) until halving and coincidence are as nearly correct as possible. It may also be necessary after this adjustment to reposition the penta prism mount as in (*n*) above.

(*p*) Replace end box sleeve.

(*q*) Replace right end buffer assembly.

b. Adjusting lath.—If the index strips of the adjusting lath (fig. 36) are found to be out of adjustment, slightly loosen the screws holding the index plates and shift the plates in or out until correct coincidence is obtained. (This is, of course, performed by two persons, one operating the range finder and the other holding the adjusting lath, who by prearranged signals make the adjustment outlined.) Check this setting with four or five readings on the adjusting lath, then permanently secure the holding screws by applying shellac varnish under heads of screws, holding index plates securely. If in attempting to set the index plates it is found that the holes in the body of the adjusting lath have not been elongated to permit the movement of these plates, the holes may be elongated in the following manner:

(1) Remove eight screws holding end caps, X73C, and remove the caps. Remove eight screws, A35625, holding index plates, X73B, and remove the plates. Elongate eight holes in adjusting lath body, C118A, for screws holding index plate so as to permit of lengthening or shortening space between the two index strips by 4 millimeters. Care should be taken in slotting to keep the width of the slots 0.112 inch in order to keep the index strips parallel. Reassemble index plates. Replace end caps, which should be filed slightly if the index plate screws prevent the caps from being reassembled in their original position.

(2) The tools required for this work are a screw driver (optical repair kit, No. 204) and a round file to fit a 0.112-inch hole.

SECTION V

80-CM BASE RANGE FINDER, M1916

14. Description.—The 80-cm base range finder, M1916, complete, consists of the range finder, tripods, types N and P, adjusting lath, type A, carrying strap, and carrying cases.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:27 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

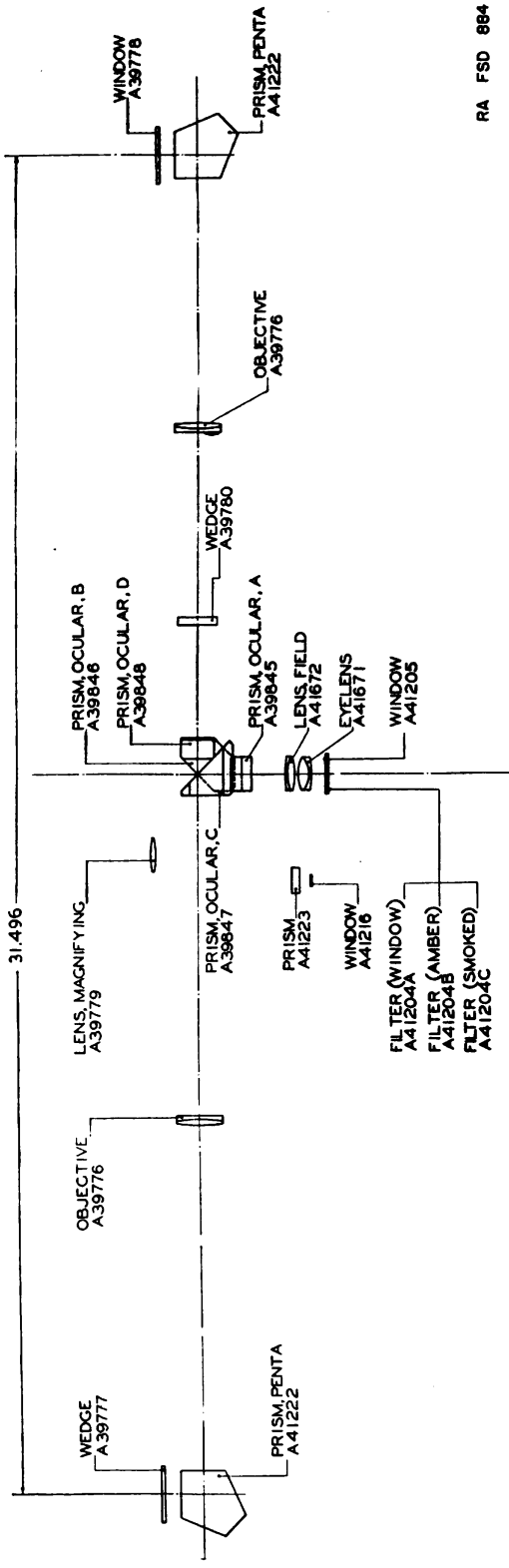


FIGURE 41.—Optical system for 80-cm base range finder, M1916.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:27 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

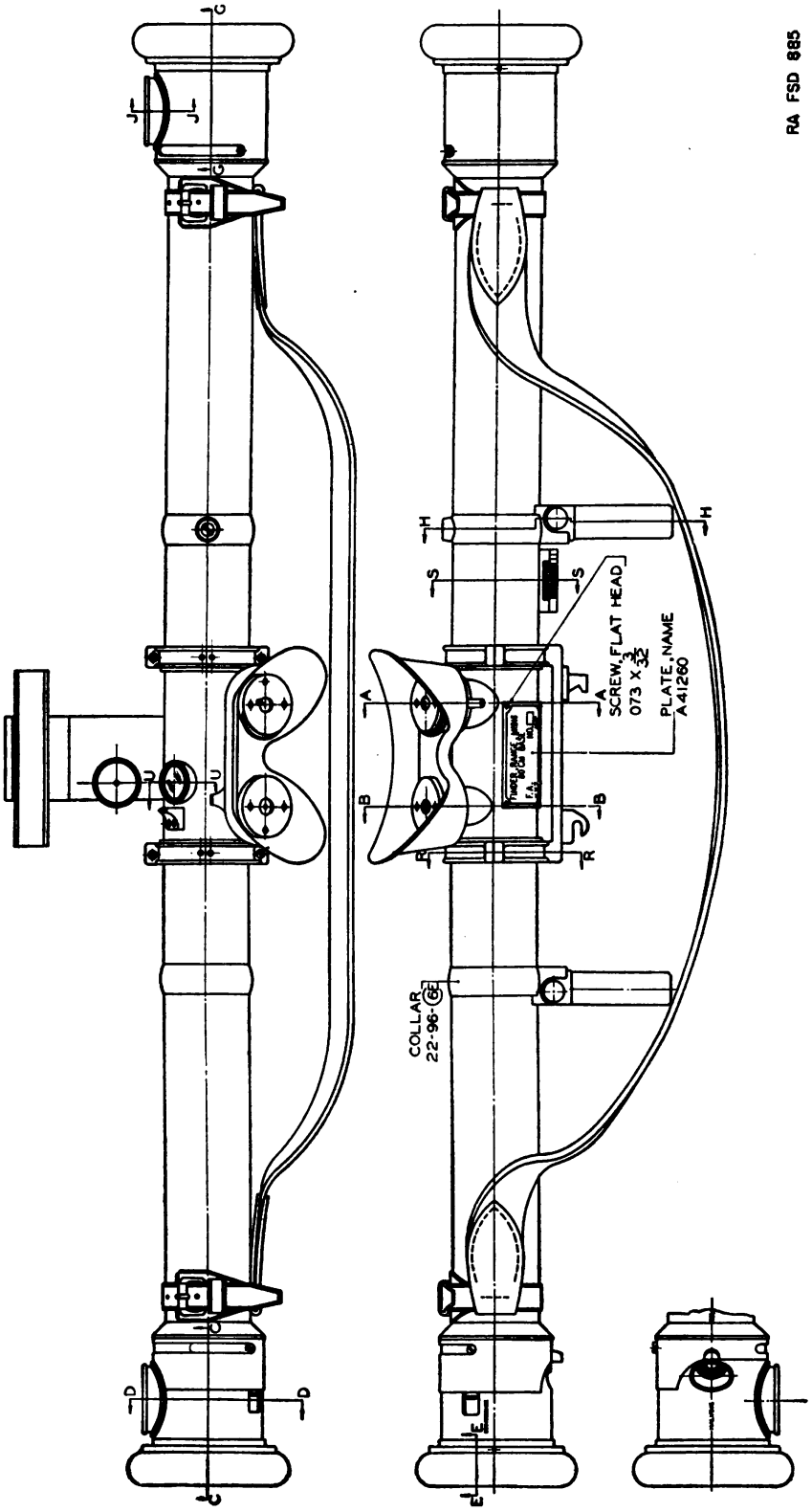


FIGURE 42.—80-cm base range finder, M1916—assembled views.

Generated on 2017-02-23 18:27 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

a. 80-cm base range finder, M1916.—The optical system of this range finder is shown in figure 41. Mechanical details are shown in figures 42 to 47, inclusive.

(1) The eyepiece is focused by moving the focusing handle, A41211 (fig. 43), of the diopter scale, A41212. An object viewed through the eyepiece presents two images, the lower image erect and the upper inverted, separated by a horizontal dividing line known as the halving line. A ray filter holder, A41206 containing an amber

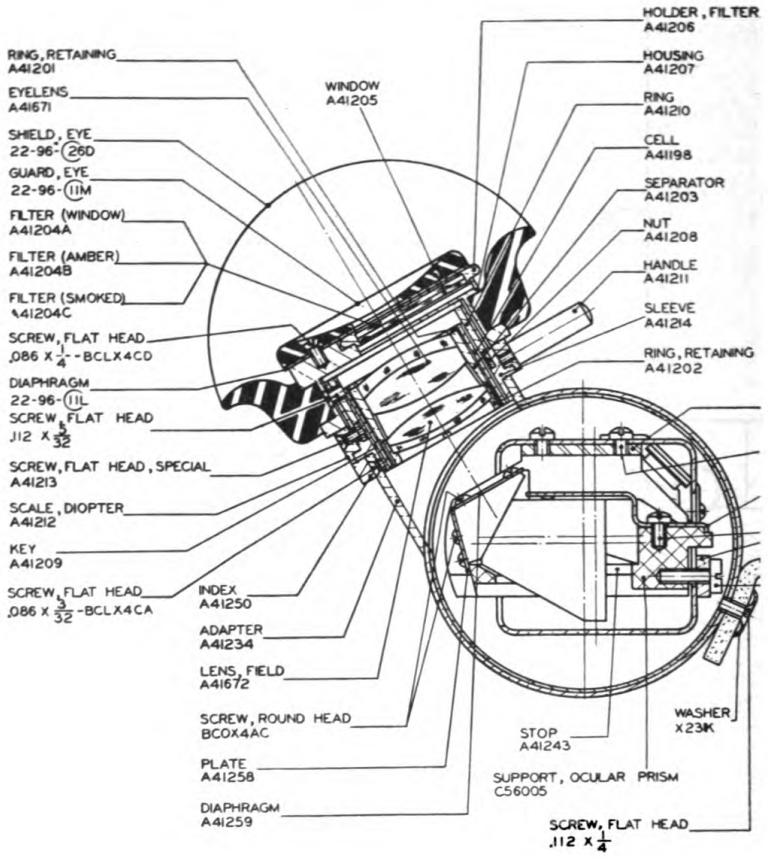
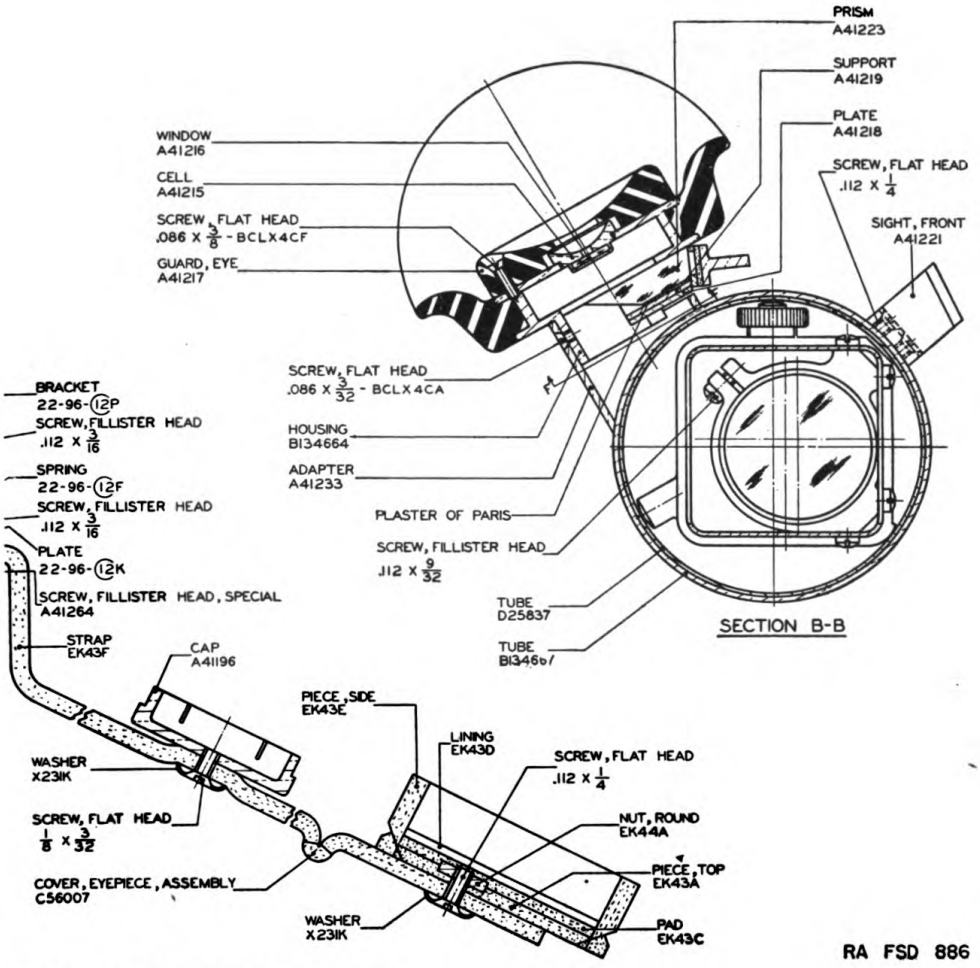


FIGURE 43.—80-cm base range finder,

ray filter, a smoked ray filter, and a clear ray filter rotates within the eyepiece housing and is controlled by means of the knurled edge which protrudes from the housing. The left eye guard, A41217, forms a peep sight for the eyepiece rear sight prism, A41223. The front sight, A41221, is visible through the eye guard when the eyepiece rear sight lever, A41220 (fig. 44), is moved to uncover the prism opening.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:28 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

(2) The measuring wedge knob, A41224 (fig. 47), is located on the under surface of the outside tube, D25837 (fig. 43). This knob actuates the measuring wedge, A39780 (fig. 46), and range scale, B134678. The range scale is graduated in yards from 400 to 10,000 and is marked with a star to indicate the infinity point. The scale is visible through the magnifying lens; A39779 (fig. 47), near the eyepiece and is read against the line of the range scale index, A41254.



M1916—sectioned views A–A and B–B.

(3) The left end box, C56006 (fig. 44), contains the mechanisms for performing the halving adjustment and the range adjustment. The halving adjusting knob, 22–96–29A, by shifting the position of the penta prism, A41222, within the end box, controls the symmetry of the eyepiece images. The end box wedge adjusting knob, A41245, controls the calibration of the range scale at coincidence. Two movable sleeves encircle the end box. The inner sleeve, B134668, contains openings

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:28 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

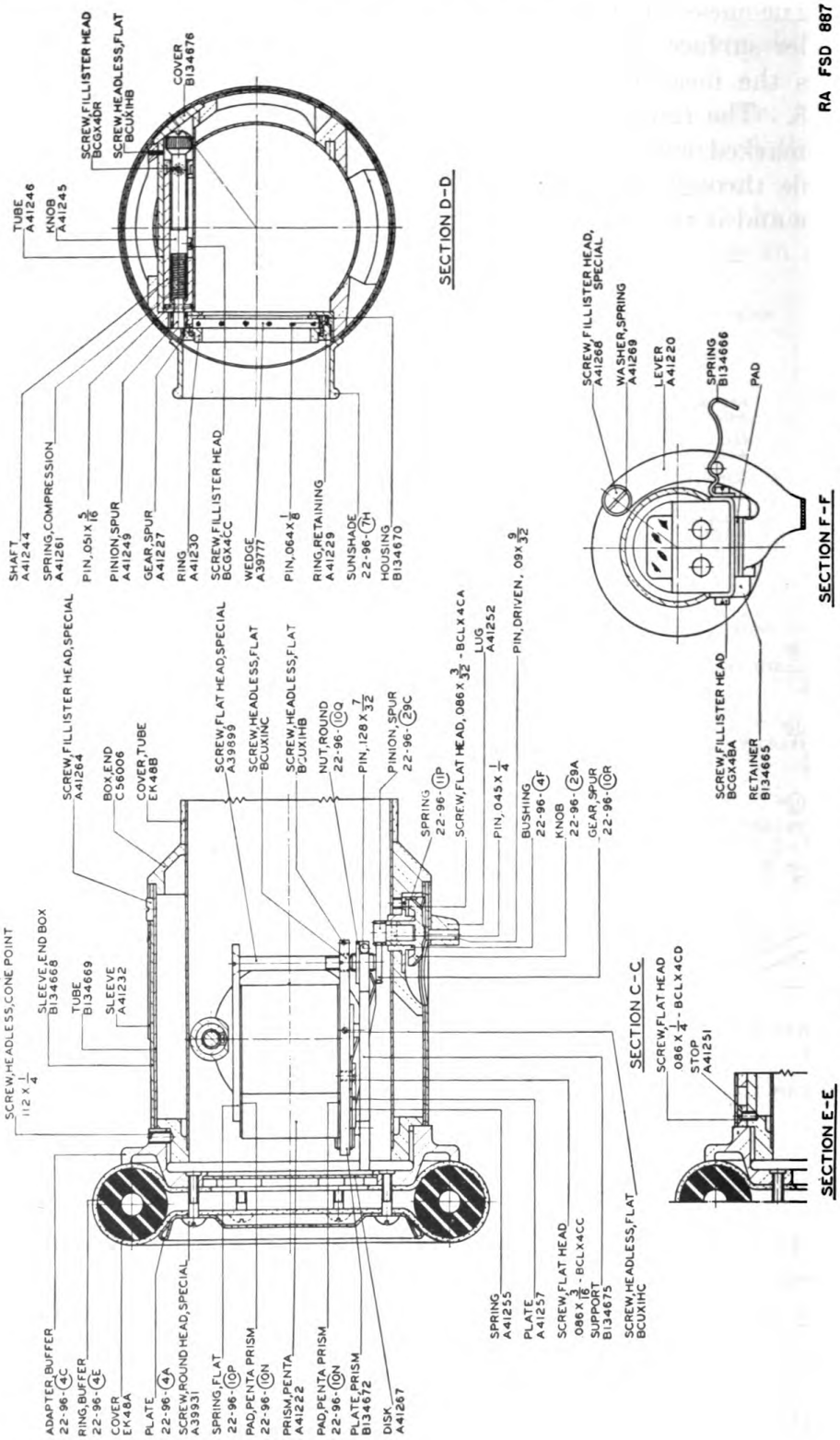


FIGURE 44.—80-cm base range finder, M1916—sectioned views C–C to F–F.

Generated on 2017-02-23 18:28 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

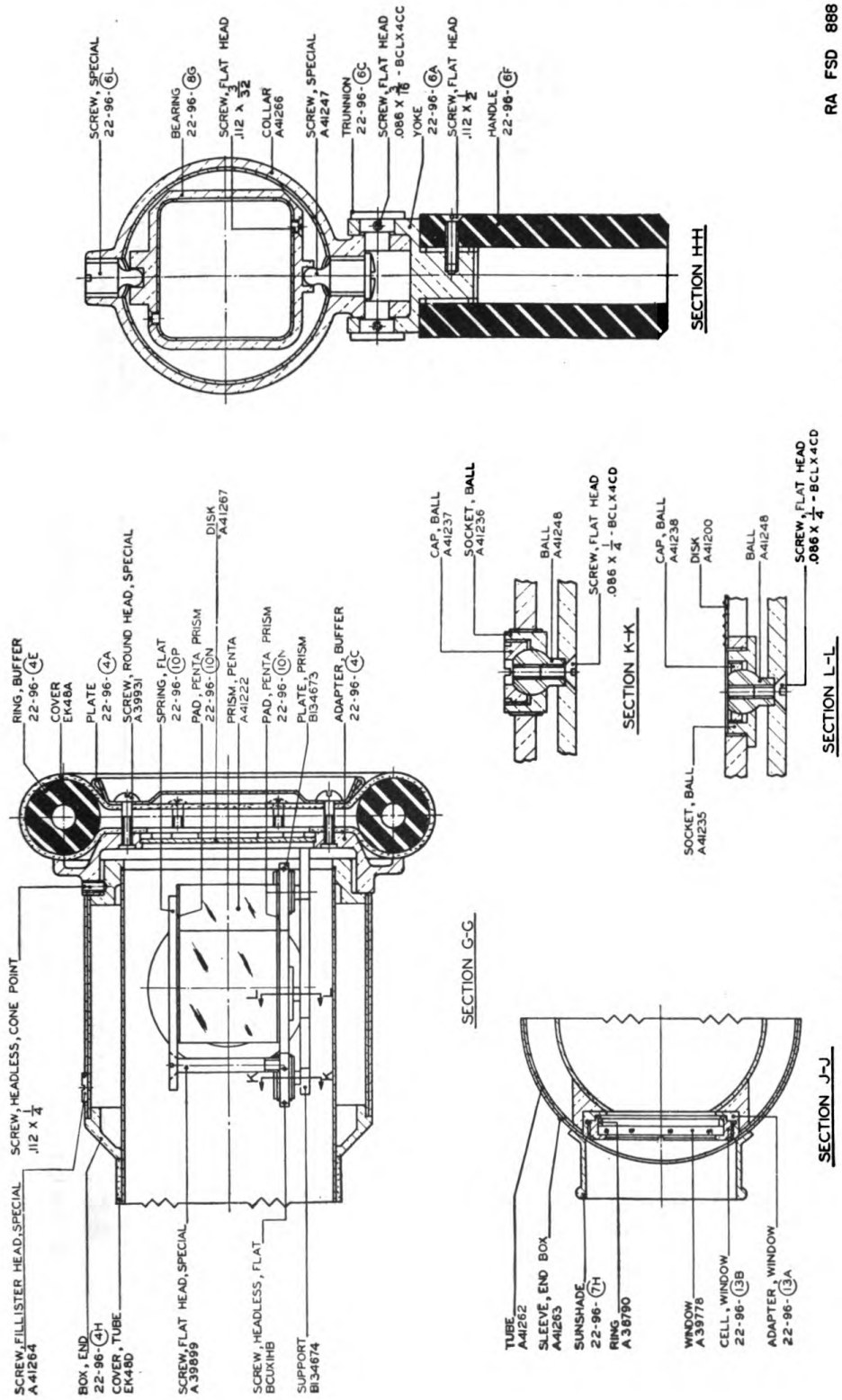


FIGURE 45.—80-cm base range finder, M1916—sectioned views G–G, H–H, J–J, K–K, and L–L.

Generated on 2017-02-23 18:28 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

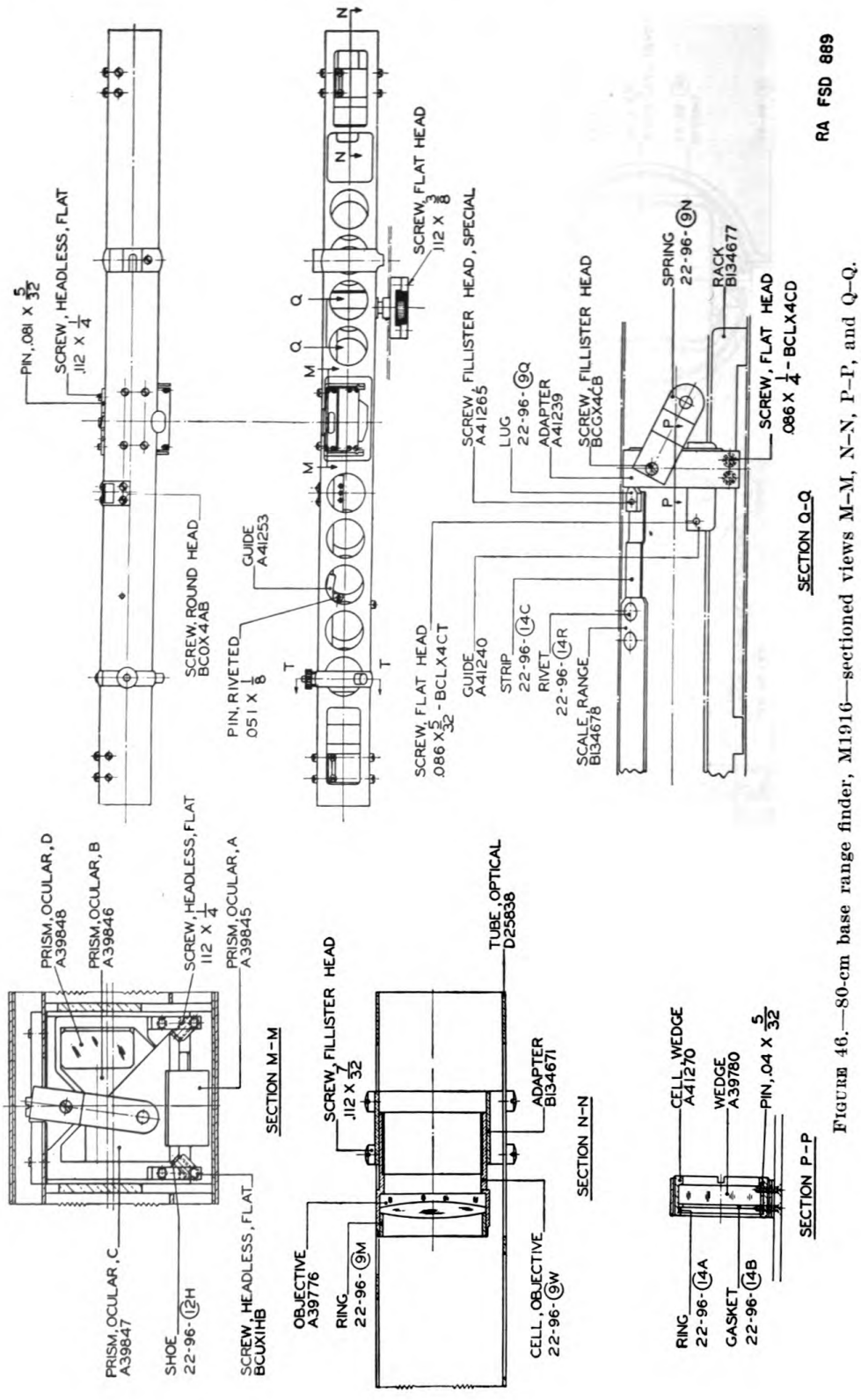


FIGURE 46.—80-cm base range finder, M1916—sectioned views M–M, N–N, P–P, and Q–Q.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:28 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

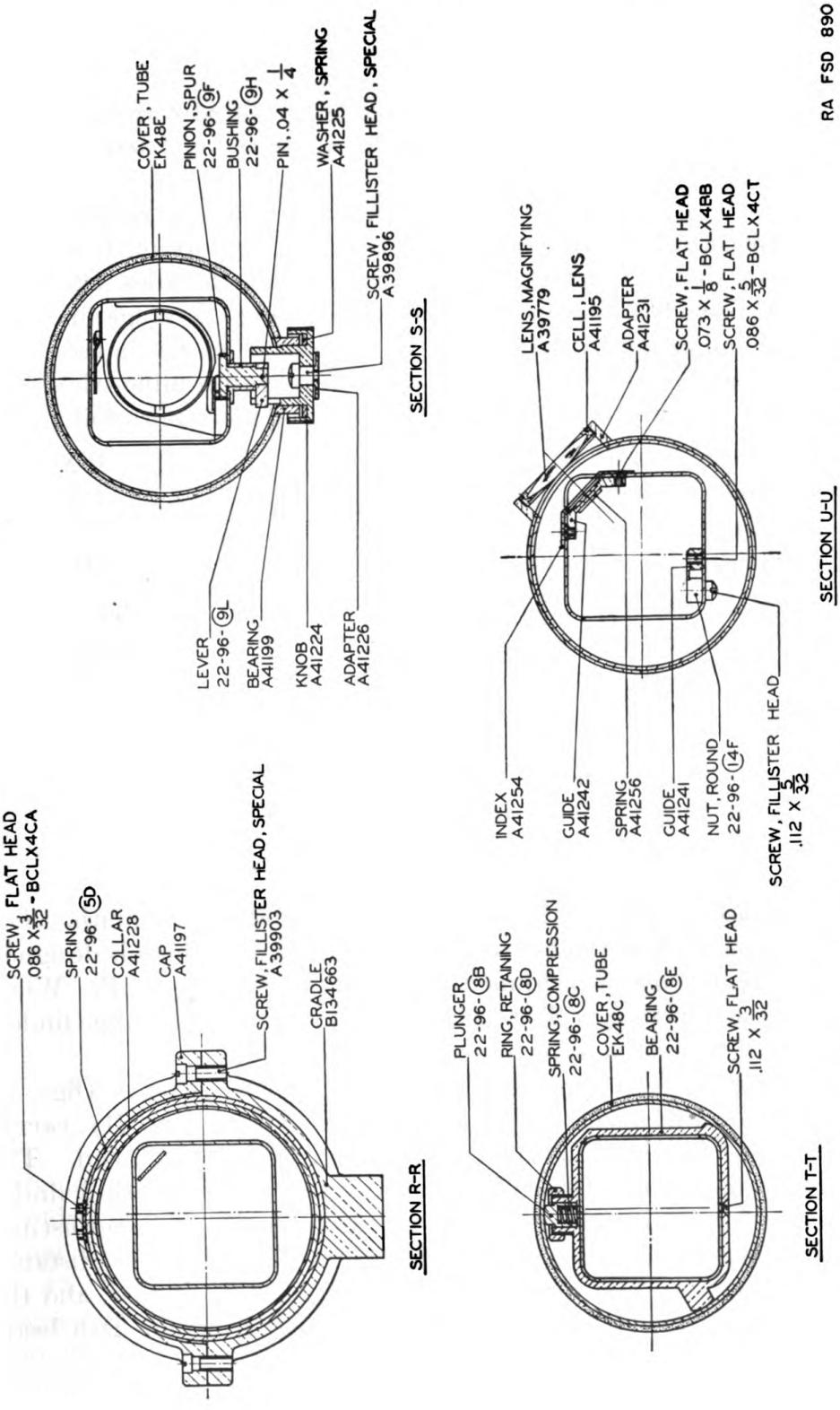


FIGURE 47.—80-cm base range finder, M1916—sectioned views R–R to U–U.

Generated on 2017-02-23 18:28 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

marked "halving" and "coincidence" which are for access to the corresponding knobs. The outer sleeve, A41232, is rotated to cover or uncover these openings.

(4) The right end box, 22–96–4H (fig. 45), is fitted with an end box sleeve assembly which can be rotated to cover the end box window, A39778.

(5) The cradle, B134663 (fig. 47), in which the tube rotates is the means for attaching the range finder to the support on the upper portion of the tripod, type P. The range finder handles, 22–96–6F (fig. 45), provide a convenient means for turning the range finder in elevation and azimuth; they can be folded back when not in use. The buffer assemblies are provided as a protection against minor shocks.

(6) The optical characteristics of the range finder are as follows:

Power	10X.
Field of view	3°30′.
Diameter of exit pupil	0.10 inch.
Aperture of objective	1.0 inch.

b. Tripods, types N and P.—The tripod, type P, is a short tripod with legs that can be folded together so as to fit into the head of the tripod, type N, as shown in figures 48 and 50, or spread to form an independent tripod structure. The head of the tripod, type P, contains a knuckle joint which permits leveling of the range finder and also permits the use of the range finder in a vertical position when ranging on objects having horizontal relief. The support, X235A (fig. 50), is formed with a latching plunger, X234A, which holds the range finder securely in position. The clamping screw, X234F, when released permits rotation of the range finder in azimuth. The tripod, type N, shown in figure 49, is a larger tripod which is designed specifically for use in conjunction with the tripod, type P. When so used, the tripod, type P, functions as a mount for the range finder. The legs of the tripod, type N, are extensible.

c. Adjusting lath, type A.—The adjusting lath, type A (figs. 51 and 71), consists essentially of a body tube, X237A (fig. 71), carrying a target bracket, X237D, and target X237E, at each end. The body tube is mounted on collapsible legs and is fitted with a finder assembly for alining the lath with the range finder when adjusting. Each adjusting lath is individually adjusted so that the distance between the targets is equal to the base of the range finder, and the laths are therefore not interchangeable. Each adjusting lath bears the same serial number as the range finder.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:29 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

d. Carrying cases.—The carrying case for range finder and tripods is shown in figure 52. The tripods, types N and P, fit into the pocket on the side of the case and are secured by means of the hood and fastening strap. The lid of the carrying case is formed with a tool pan which is covered by the lid cap and which is used for carrying small items of equipment such as the camel's-hair brush. A separate carrying case is provided for the adjusting lath. Before

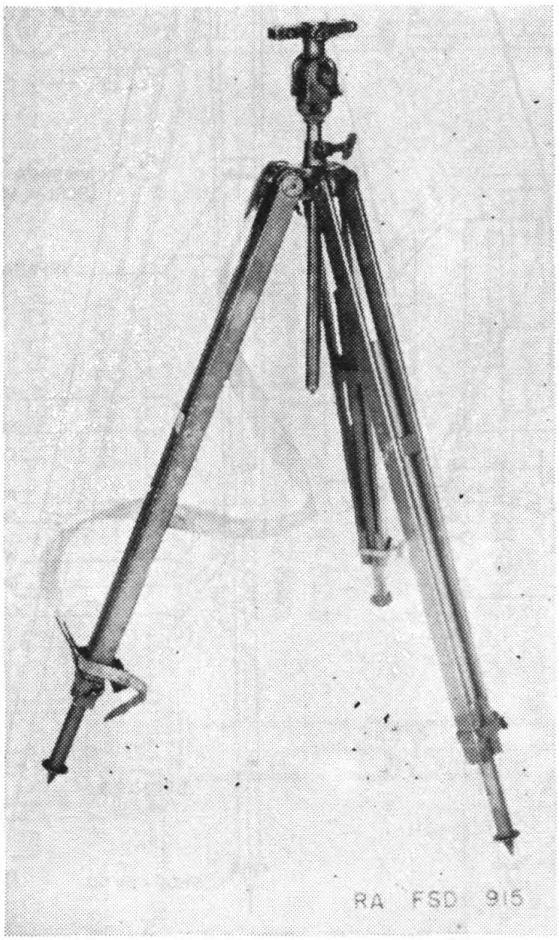


FIGURE 48.—Tripods, types N and P.

the adjusting lath is placed in the carrying case, the legs should be folded in against the body tube and the finder should be turned so that it is parallel to the body tube.

15. Operation.—*a. Range measurement.*—(1) To measure the range of an object, select a clearly defined part perpendicular, if possible, to the halving line. Move the instrument in azimuth and elevation as required to bring the part to the center of the field of

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:29 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

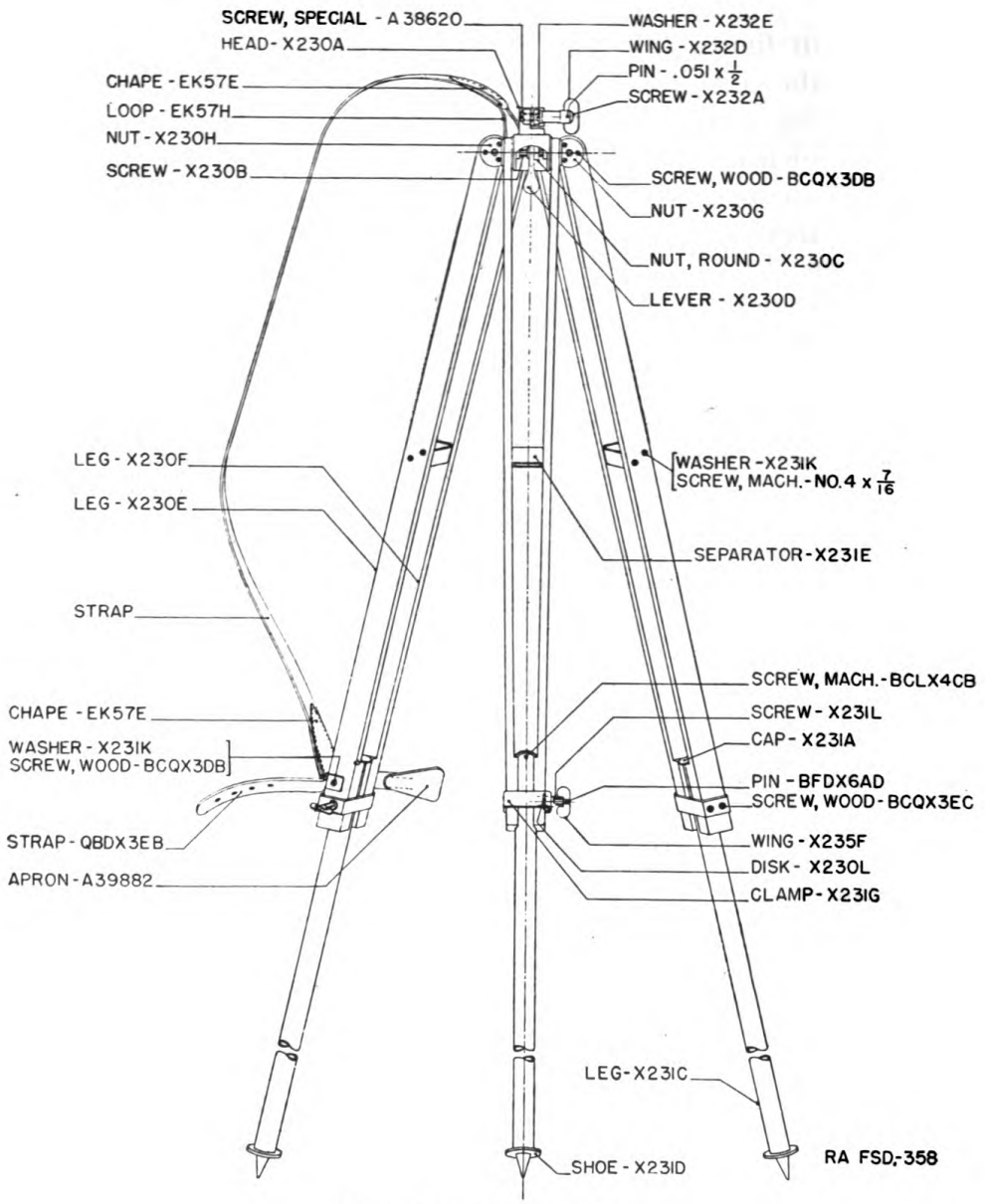


FIGURE 49.—Tripod, type N.

view. When first observed, the images will ordinarily not be in coincidence (fig. 19①). Turn the measuring wedge knob until the images of the point selected appear in coincidence (fig. 19②). Read the range in yards on the range scale opposite the index.

(2) Ranges of objects which have no prominent vertical parts, such as roads, trenches, crests of ridges, etc., can be measured by loosening the wing nut of the tripod, type P, and rotating the range finder to a vertical position. The images when first observed will

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:29 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

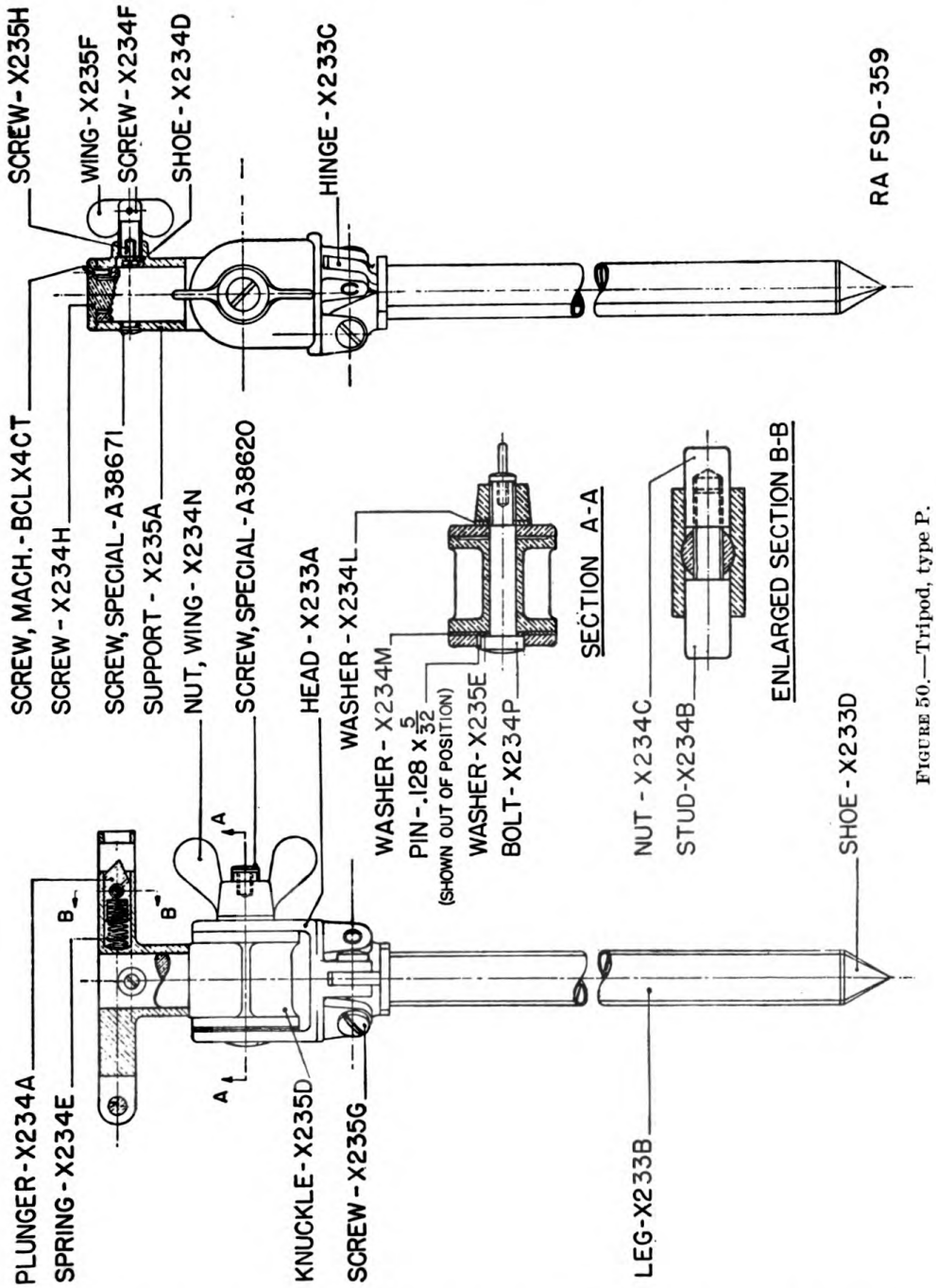


FIGURE 50.—Tripod, type P.

ordinarily not be in coincidence (fig. 19③). Turn the measuring wedge knob until the image of the horizontal line appears to continue across the halving line (as at A in fig. 19④).

b. Field adjustment.—(1) *Halving adjustment.*—Incorrect adjustment of the halving line is indicated by the failure of the corre-

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:29 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

sponding points on the inverted and erect images to fall on the halving line (fig. 20). To correct the halving adjustment, turn the end box outer sleeve to expose the opening marked "halving," and rotate the halving adjusting knob until the corresponding point of each image touches the halving line (as in fig. 19① and ②). A sharply defined point at least 400 yards away must be used for this adjustment. Return the sleeve to its original position when the adjustment is completed.

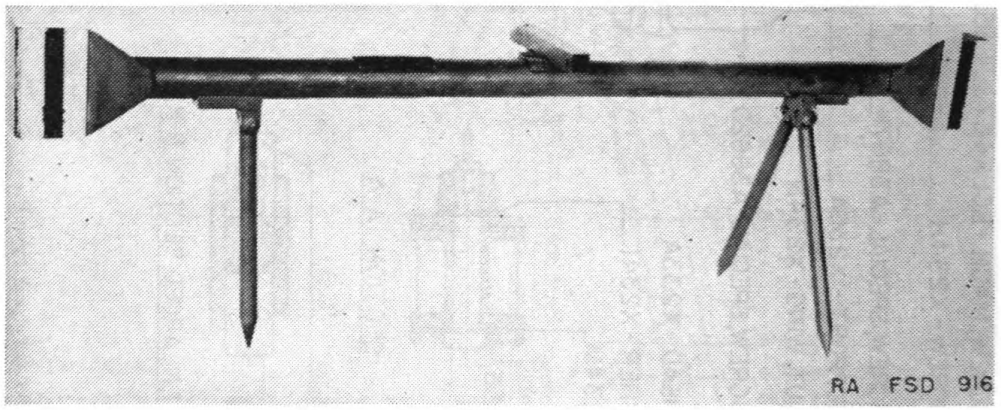


FIGURE 51.—Adjusting lath, type A.

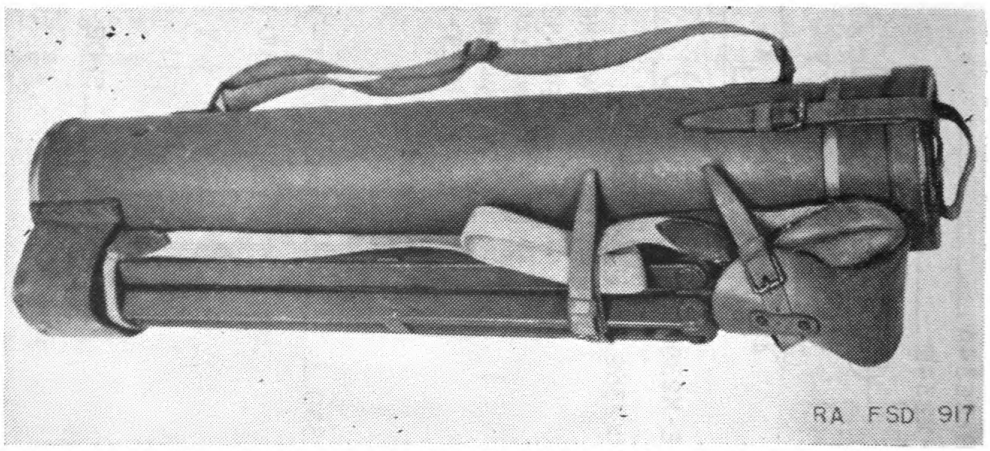


FIGURE 52.—Carrying case for 80-cm base range finders, M1916 and M1918.

(2) *Range indications.*—(*a*) To test the instrument using a finite range, select a sharply defined object at a distance of 400 yards or more, the range of which is accurately known, and bring the object into coincidence in the center of the field of view (fig. 19②). If the range adjustment is correct, the known range should be indicated.

(*b*) To test instrument by the infinity method, set up the adjusting lath in a horizontal position at least 125 yards from the instrument

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:29 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

(use the finder of the lath to insure perpendicularity to the line of sight), and set the range scale to indicate infinity (*). If the images appear alined as in figure 21② the adjustment is correct; misalinement, such as is shown in figure 21①, indicates the necessity for adjustment.

(*c*) To adjust the instrument in range, set the range scale at the known range or at infinity, depending on the method of test employed, turn the end box outer sleeve to expose the opening marked "coincidence," and bring the images into correct relation by rotating the end box wedge adjusting knob. Return the sleeve to its original position when the adjustment is completed.

(*d*) When the adjusting lath is used, it must be the one belonging with the particular range finder. The same serial number is provided on both.

16. Inspection.—Inspection is for the purpose of determining the condition of the instrument, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning.

a. Range finder.

Parts to be inspected	*Points to be observed*
(1) Exposed mechanical parts.	(1) Observe general appearance, smoothness of operation of knobs, end box sleeves, ray filter holder, etc., and bent or missing parts.
(2) Peep sight.	(2) Line of sight should intersect optical line of sight within a tolerance of approximately 10 mils.
(3) Eyeshield.	(3) The eyeshield requires replacement if torn or otherwise damaged.
(4) Optical system.	(4) Note if checks or frost patterns appear in the field of view. Such defects are evidence of loosening of the balsam used in cementing prisms and lenses and, if severe, require the return of the instrument to an arsenal for overhaul.
(5) Diopter scale.	(5) Using the collimating telescope (optical repair kit, No. 90) focus the eyepiece for sharpness and clearness of definition of the halving line and of both images. The read-

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:29 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Parts to be inspected	*Points to be observed*
	ing of the diopter scale at optimum focus should be approximately zero.
(6) Halving adjustment.	(6) Adjust the range finder to correct halving. If proper adjustment cannot be obtained, or if halving adjusting knob is very near its limit, halving adjusting mechanism requires overhaul.
(7) Coincidence adjustment.	(7) Adjust instrument for range, preferably using a datum point of known range. If proper adjustment cannot be obtained, or if end box wedge adjusting knob is very near its limit, the penta prism or end box wedge is out of adjustment.
(8) Prisms.	(8) Check a sharply defined object for halving at each edge and at the center of the halving line. If halving cannot be maintained without readjustment, it is an indication that the ocular or penta prisms have shifted.
b. Adjusting lath.	
(1) Exposed mechanical parts.	(1) Note loose or missing screws and any damaged parts. See that the legs fold properly and that the finder operates as intended.
(2) Name plate.	(2) Serial number of adjusting lath should be the same as range finder.
(3) Straightness.	(3) If bent so that the space between index lines is shortened, the lath should be corrected.
(4) Alinement.	(4) Set up the range finder on its tripod or on V-blocks (optical repair kit, No. 75). Place the adjusting lath at a distance of 125 yards in front of the range finder and parallel to it so that the range finder appears in the center of the field of view when sighting through the

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:29 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Parts to be inspected	*Points to be observed*
	finder of the lath. Check the range adjustment against a fixed reference target at medium distance (500 to 2,000 yards), the range of which is accurately known. Make four or five check readings and then set range scale to read infinity. Direct the range finder on the adjusting lath. If the targets are in coincidence, they are properly spaced.

17. Maintenance and repair.—Repairs which necessitate disassembling and assembling operations are limited to those which do not affect the optical alinement of the instrument. Repairs involving realinement, removal, or replacement of optical parts, or other repairs which cannot be made with the facilities available will require that the instrument be turned in to the base shop.

a. Eyepiece.—To disassemble the external eyepiece parts, remove the three flat head screws securing the eye guard and lift off the eye guard, eyepiece diaphragm, and ray filter holder. To release ray filters remove screw holding ray filter clamping washer to ray filter holder. If ray filter holder is too loose or too stiff in operation, bend detent portion of eyepiece diaphragm in or out as required. Clean eyelens before reassembling parts.

b. Range finder handles.—Handles are threaded in place and secured by flat head locking screws. The special screw, A41247 (fig. 45), in the right handle collar supports the optical tube and is not to be disturbed in disassembling the handle.

c. Halving adjustment.—The pair of special screws, 22–96–6L and A41247, in the right handle collar positions the ocular tube within the outside tube and hence serves to locate the halving line when the penta prisms have been properly set. Adjustment is required only where obvious misalinement of the optical tube is indicated, and should not be attempted where the penta prisms are known to be out of position.

Section VI

80-CM BASE RANGE FINDERS, M1917 AND M1917MI

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:29 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

18. Description.—The 80-cm base range finder, M1917 (or M1917MI), complete, consists of the range finder, tripods, types R and S, correction wedge key, camel's-hair brush, carrying strap, and carrying cases.

a. 80-cm base range finders, M1917 and M1917MI.—(1) The M1917 instrument and the M1917MI instrument are generally the same, differing mainly in the design of the halving adjusting parts. Both employ the same optical system shown in figure 53. Mechanical details of these range finders are shown in figures 54 to 61, inclusive.

(2) The eyepiece is focused by rotation of the diopter scale, X174C (figs. 55 and 59). An object viewed through the eyepiece appears erect in a circular field with a horizontal band across its center in which is seen the inverted image of the object ranged on. The lower edge of the horizontal band is the halving line. The ray filter lever, X140A (figs. 54 and 58), near the eyepiece controls a ray filter holder containing an amber filter, A40518 (figs. 55 and 59), and a smoked ray filter, A40519. The amber ray filter is used to moderate exceptionally bright daylight or the reflection of the sun over water; the smoked ray filter is used for observing into the direct rays of a searchlight.

(3) Range measurements are made by means of a distance scale which appears in the field of view directly below the halving line. This type of operation is made possible by using an optical system in which the right and left objectives have slightly different powers of magnification. Swinging the instrument in azimuth about its vertical axis causes the erect and inverted images to traverse the field at slightly different rates so that coincidence for an object at any given range is obtained at only one location in the field. The distance scale is graduated to show ranges of objects situated from 450 yards to an infinite distance from the instrument and is engraved on the reticle, B129958, of the ocular prism assembly. The major graduations of the distance scale represent multiples of 100 yards and the subscript graduations represent 50-yard intervals. Submultiple graduations (not shown) are provided for smaller intervals.

NOTE.—These instruments were originally graduated in meters and were later modified to read yards by internal adjustment of the optical system. The word "yards" appears on the eyepiece arch of modified instruments.

(4) The central optical parts are mounted in a separate optical tube, WN10A (M1917, fig. 56), D25781 (M1917MI, fig. 60), within the outside tube, WN8A (M1917, fig. 55), D25778 (M1917MI, fig. 59). This optical tube is supported at the left end in the gimbal joint

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:29 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

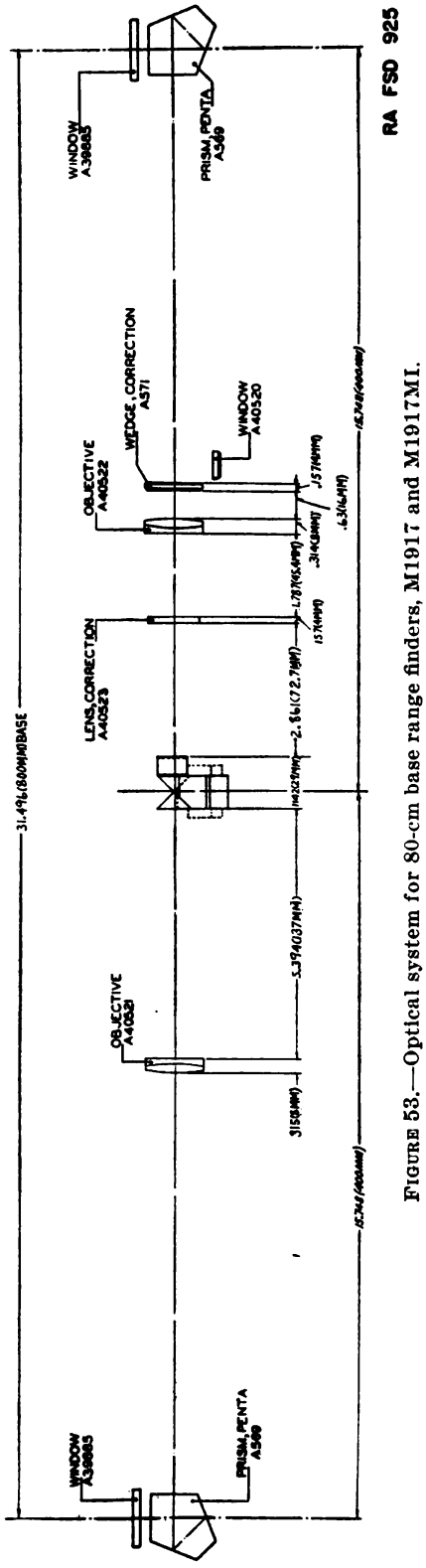


FIGURE 53.—Optical system for 80-cm base range finders, M1917 and M1917MI.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:30 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

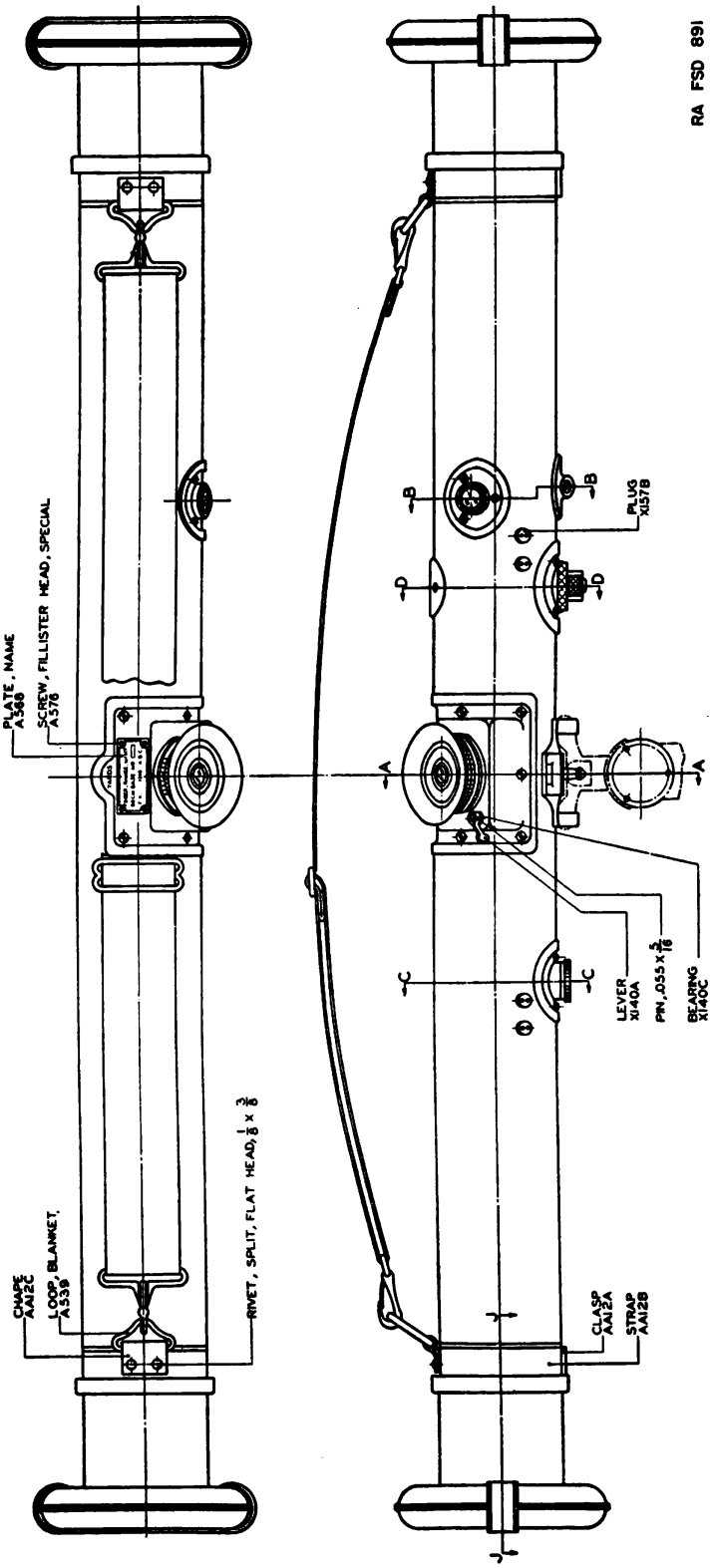


FIGURE 54.—80-cm base range finder, M1917—assembled views.

Generated on 2017-02-23 18:30 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

fork, X244C (figs. 56 and 60), and the right end may be raised or lowered for halving adjustment. The appearance of the optical tube assembly and the method of support are shown in figures 56 and 60. In the M1917 instrument, the halving adjusting knob, WN5C (fig. 55), operates a halving adjusting screw, WN9B, which raises or lowers the optical tube against the action of a compression spring, WN11D. In the M1917MI instrument, the optical tube is supported in a swivel ring, A40338 (fig. 59), which is actuated by the halving adjusting knob, X71F (fig. 61), to provide a similar adjustment in height.

(5) The correction wedge shaft, X143A (figs. 55 and 59), operates the correction wedge, A571 (figs. 56 and 60), and the correction wedge scale, X169C (figs. 55 and 59). The graduations of this scale are in arbitrary units. A correction wedge key is supplied with the instrument to fit the squared end of the shaft.

(6) The end box assemblies at each end of the outside tube contain the penta prisms, A569 (figs. 57 and 61), and the end box windows, A39885. The end box sleeves, X180C, can be rotated to to cover the window openings and thereby guard against the entrance of dirt or dust. The buffer assemblies are provided as a protection against minor shocks.

(7) The range finder adapter, X142A (figs. 55 and 59), assembled to the outside tube below the eyepiece is the means for attaching the range finder to the support on the upper portion of the tripod, type S.

(8) The optical characteristics of the range finder are as follows:

Power	10X.
Field of view	4°30′.
Diameter of exit pupil	0.09 inch.

b. Tripods, types R and S.—The tripod, type S, is a short tripod with legs that can be folded together so as to fit into the head of the tripod, type R, as shown in figure 33, or spread to form a tripod structure, as in figure 35. The head of the tripod, type S, contains suitable mechanisms for traversing, lateral leveling, and elevating of the range finder so that the tripod, in effect, functions as a mount for the range finder. The tripod, type R, shown in figure 34, is a larger tripod which is designed specifically for use in conjunction with the tripod, type S.

c. Carrying cases.—The carrying case for range finder and tripod is shown in figure 37. The tripod, type R, fits into the pocket on the side of the case and is secured by means of the hood and fasten-

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:30 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

ing strap. The lid of the carrying case is formed with a tool pan which is covered by the lid cap and which is used for carrying small items of equipment, such as the correction wedge key, camel's-hair

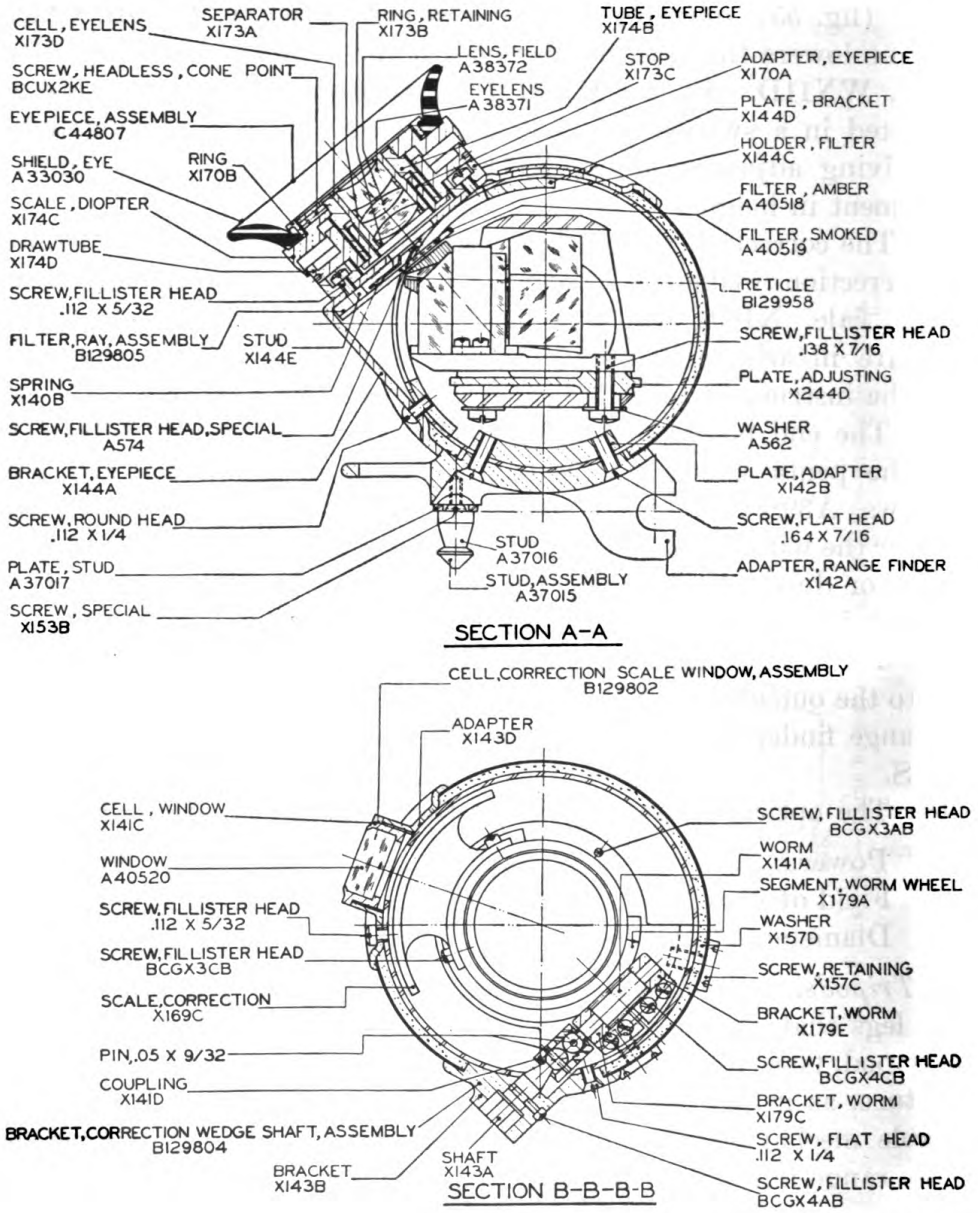


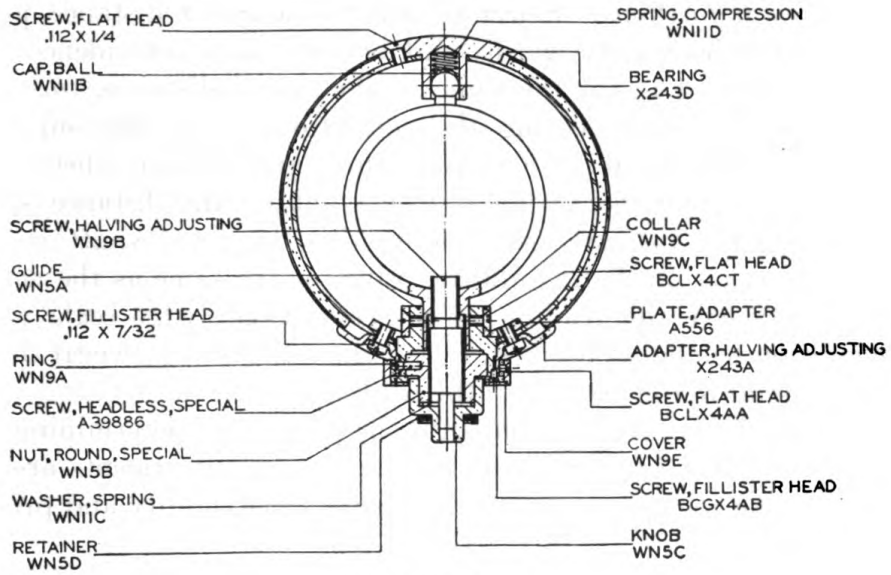
FIGURE 55.—80-cm base range finder, M1917—

brush, etc. A separate canvas carrying case is furnished for the tripod, type S.

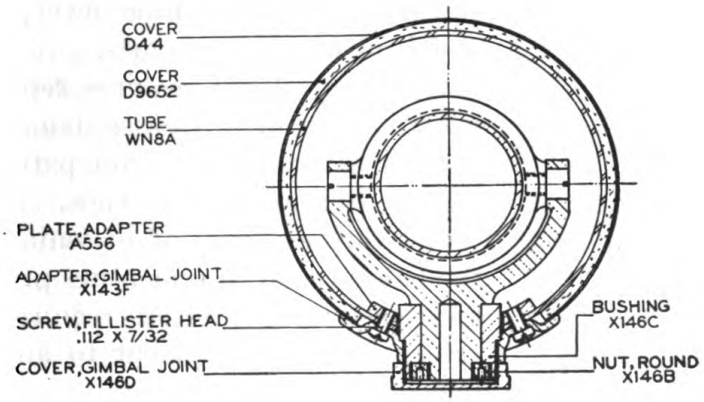
19. Operation.—*a. Range measurement.*—To measure the range of an object, train the instrument on the object to be measured, using

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:31 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

the elevating knob of the tripod, type S, to bring the object to the halving line. When first observed, the images will ordinarily not be in coincidence (fig. 62①). Obtain coincidence by moving the range finder in azimuth until the two images are in perfect alinement (fig. 62②). Read the range indicated by the scale directly below the



SECTION D-D



SECTION C-C RA FSD 892

sectioned views A–A, B–B–B–B, C–C, and D–D.

point of coincidence (in the figure shown the range is 900 yards). To increase the accuracy of the measurement take the average of a series of readings.

b. Field adjustment.—(1) *Halving adjustment.*—Incorrect adjust-

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:31 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

ment of the halving line is indicated by the failure of the corresponding points on the inverted and erect images to fall on the halving line (fig. 63). To correct the halving, turn the halving adjusting knob until the corresponding point of each image touches the halving line (fig. 62① and ②). A sharply defined point at least 450 yards away must be used for this adjustment.

(2) *Range indications.*—Select an object at a known distance, preferably one at about 1,000 yards, and bring it into coincidence. If the range obtained is not the same as the actual distance, turn the correction wedge shaft (using the correction wedge key supplied with the instrument) about a quarter turn, and observe whether or not the images coincide at the proper point on the distance scale. Should the error increase when doing this, turn the shaft in the opposite direction until the indicated range is the same as the actual distance. Observe the reading of the correction wedge scale when this condition has been obtained, repeat the adjustment several times, and set the scale to the average of the readings.

20. Inspection.—Inspection is for the purpose of determining the condition of the instrument, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning.

Parts to be inspected	*Points to be observed*
a. Exposed mechanical parts.	*a.* Observe general appearance, smoothness of operation of knobs, end box sleeves, ray filter lever, etc., and bent or missing parts.
b. Eyeshield.	*b.* The eyeshield requires replacement if torn or otherwise damaged.
c. Optical system.	*c.* Note if checks or frost patterns appear in the field of view. Such defects are evidence of loosening of the balsam used in cementing prisms and lenses and if severe require the return of the instrument to an arsenal for overhaul.
d. Diopter scale.	*d.* Using the collimating telescope (optical repair kit, No. 90) focus the eyepiece for sharpness and clearness of definition of the halving line and of both images. The reading of the diopter scale at optimum

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:31 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Parts to be inspected	*Points to be observed*
	focus should be approximately zero. If not, diopter scale should be reset.
e. Halving adjustment.	*e.* Adjust range finder to correct halving. If proper adjustment cannot be obtained, or if halving adjusting knob is very near its limit, halving adjustment mechanism requires overhaul.
f. Prisms.	*f.* Bring several objects at progressively increasing distances into coincidence at the halving line. If halving cannot be maintained without readjustment, it is an indication that the ocular or penta prisms have shifted.
g. Correction wedge.	*g.* Adjust instrument to indicate correctly the known range of a datum point at medium distance. If proper adjustment cannot be obtained, or if correction wedge scale indicates too far from center, the correction wedge mechanism is out of adjustment.

21. Maintenance and repair.—Repairs which necessitate disassembling and assembling operations are limited to those which do not affect the optical alinement of the instrument. Repairs involving realinement, removal or replacement of optical parts, or other repairs that cannot be made with the facilities available will require that the instrument be turned in to the base shop.

a. Eyeshield.—The eyeshield is of soft rubber, molded to fit between the grooves of the diopter scale and eyeshield ring. It can be removed by unscrewing the eyeshield ring. Be careful not to damage the threads in replacing. Use lukewarm water to clean the eyeshield. Replace eyeshield if torn or otherwise damaged.

b. Diopter scale.—The diopter scale can be removed or reset by backing off the three headless cone point screws which are exposed after disassembling the eyeshield and eyeshield ring. These screws fit into a V-groove in the eyepiece tube and if backed off sufficiently allow the scale to be lifted free. When replacing the diopter scale, focus the eyepiece to present a sharp image when viewed through the

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:31 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

collimating telescope (optical repair kit, No. 90), set the diopter scale to indicate zero at this focus, and secure in position. Make certain that the headless screws seat below the surface before replacing the eyeshield and eyeshield ring.

c. Dismounting.—Dismounting is accomplished through the right hand end of the range finder. The procedure outlined below must be carefully followed in order to maintain the alinement of the optical parts.

(1) Remove right end buffer assembly (right hand thread).

(2) Remove end box sleeve

(3) Remove end box retaining ring, X158C (figs. 57 and 61).

(4) Remove end box, X180B. Mark position. The end box is secured to its adapter by three drive pins.

(5) Remove right penta prism mount, X154C, by removing the three fillister head screws.

(6) Remove end box adapter, X155B, secured by three flat head screws under strap and threaded in place. Mark position.

(7) Remove correction scale window adapter, X143D (figs. 55 and 59), with window and cell.

(8) Remove correction wedge shaft bracket, X143B, and coupling, X141D.

(9) Remove two external screws securing correction wedge mounting adapter, WN12A (figs. 56 and 60), and pull adapter out through end of tube, using drill rod hooks.

(10) Remove eyepiece bracket, X144A (figs. 55 and 59), secured by 7 screws. Before removing the last screw, hold the bracket plate by means of wires hooked through empty screw holes to prevent the plate from falling into the interior and possibly damaging the ocular prism assembly. Mark locating lines around bracket to insure proper positioning when reassembling.

(11) Remove range finder adapter, X142A.

(12) Remove halving adjusting parts. These parts are different in the two models. Refer to figure 55, section D–D; figure 59, section D–D; and figure 61, section K–K. For the M1917 range finder, be careful not to drop the compression spring and ball cap into the interior when removing the halving adjusting bearing, X243D. For the M1917MI range finder, remove also the two external retaining screws which secure the halving adjusting yoke, X71A.

(13) Remove screws holding gimbal joint adapter, X143F (section C–C). Open gimbal joint cover, X146D, and remove round nut, X146B.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:31 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

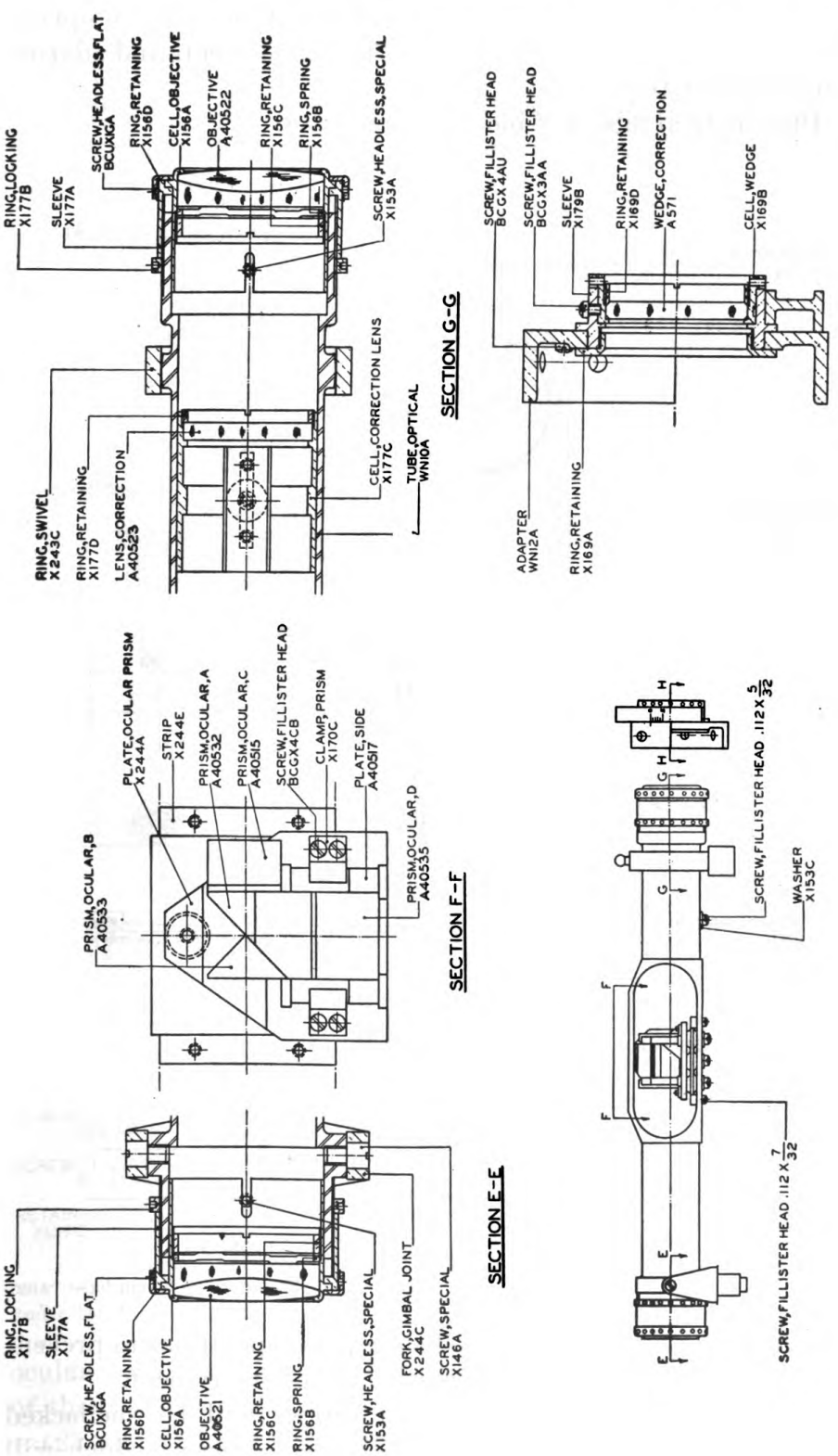


FIGURE 56.—80-cm base range finder, M1917—sectioned views E–E to H–H.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:32 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

(14) Tilt gimbal joint yoke to the right and withdraw the optical tube gently, taking precautions to protect optical elements and adapter plates inside outer tube.

(15) Place optical tube in V-blocks properly set.

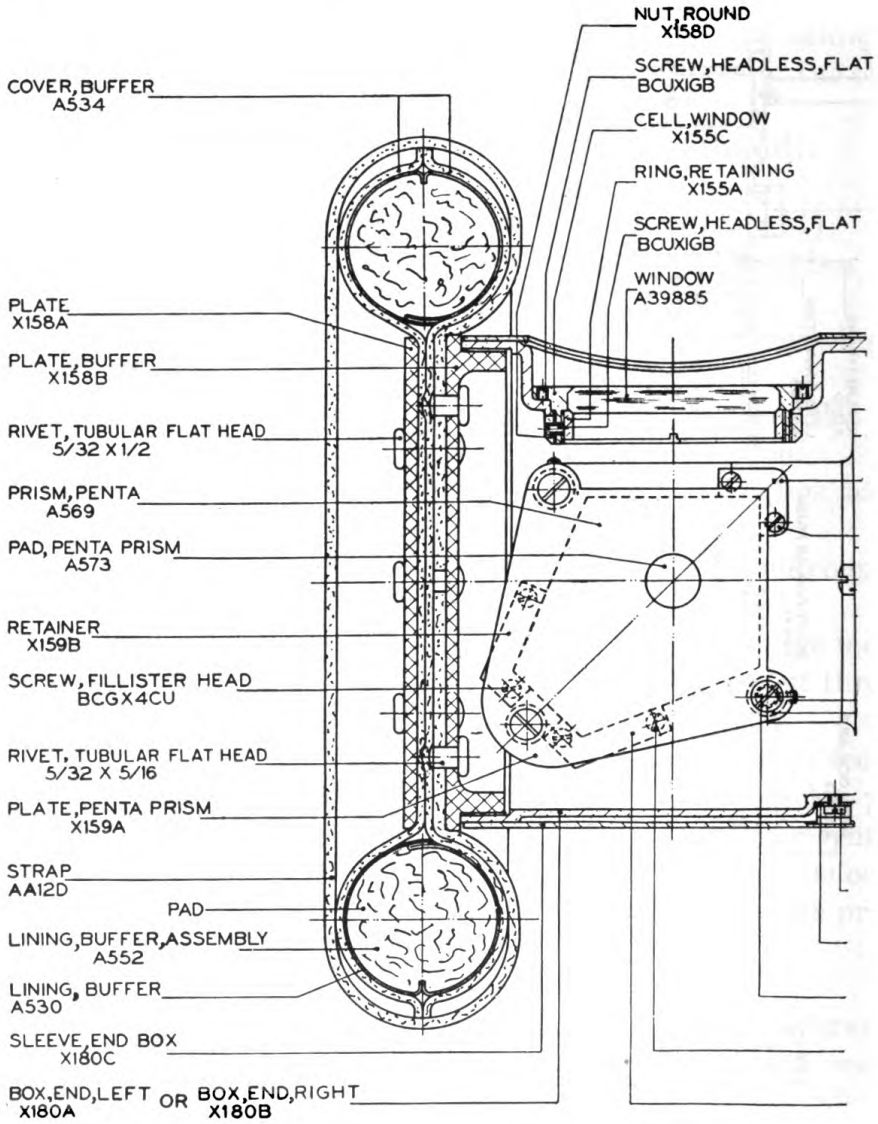


FIGURE 57.—80-cm base range

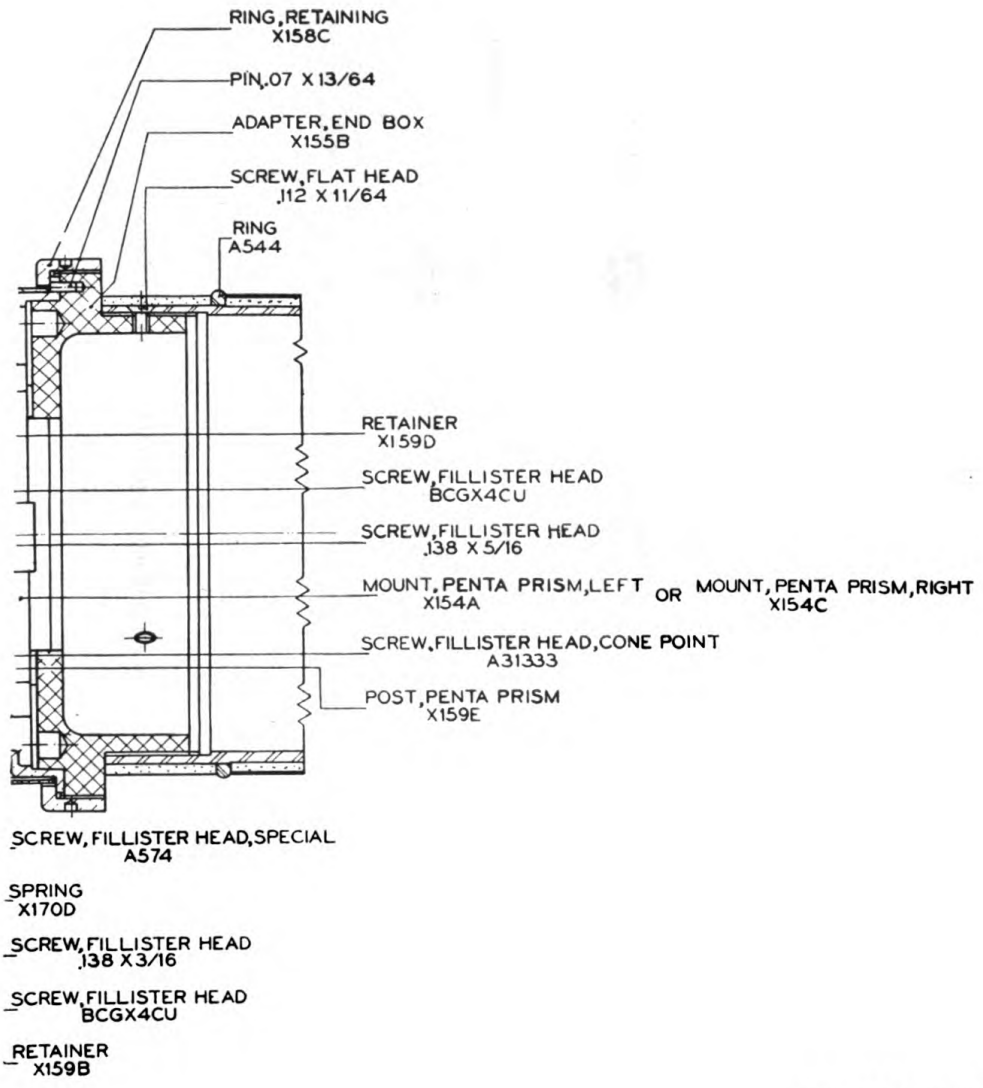
(16) Extreme care must be taken during these operations to prevent entrance of foreign matter to the interior of the instrument.

d. Reassembling.—In assembling, all screws will be shellacked under head and all outside joints will be sealed. Screws which will

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:32 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

be disturbed in adjusting will not be shellacked until all adjustments have been made.

(1) Place adapter plates on optical tube in their proper positions. Slide optical tube assembly into outside tube. Exercise care that



finder M1917—sectioned view J–J.

ocular prism does not bear on the tube to avoid possible chipping of the ocular prism.

(2) Replace gimbal joint adapter, X143F, using threaded drill rod to pick up and maneuver the adapter plate. Tighten adapter

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:32 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

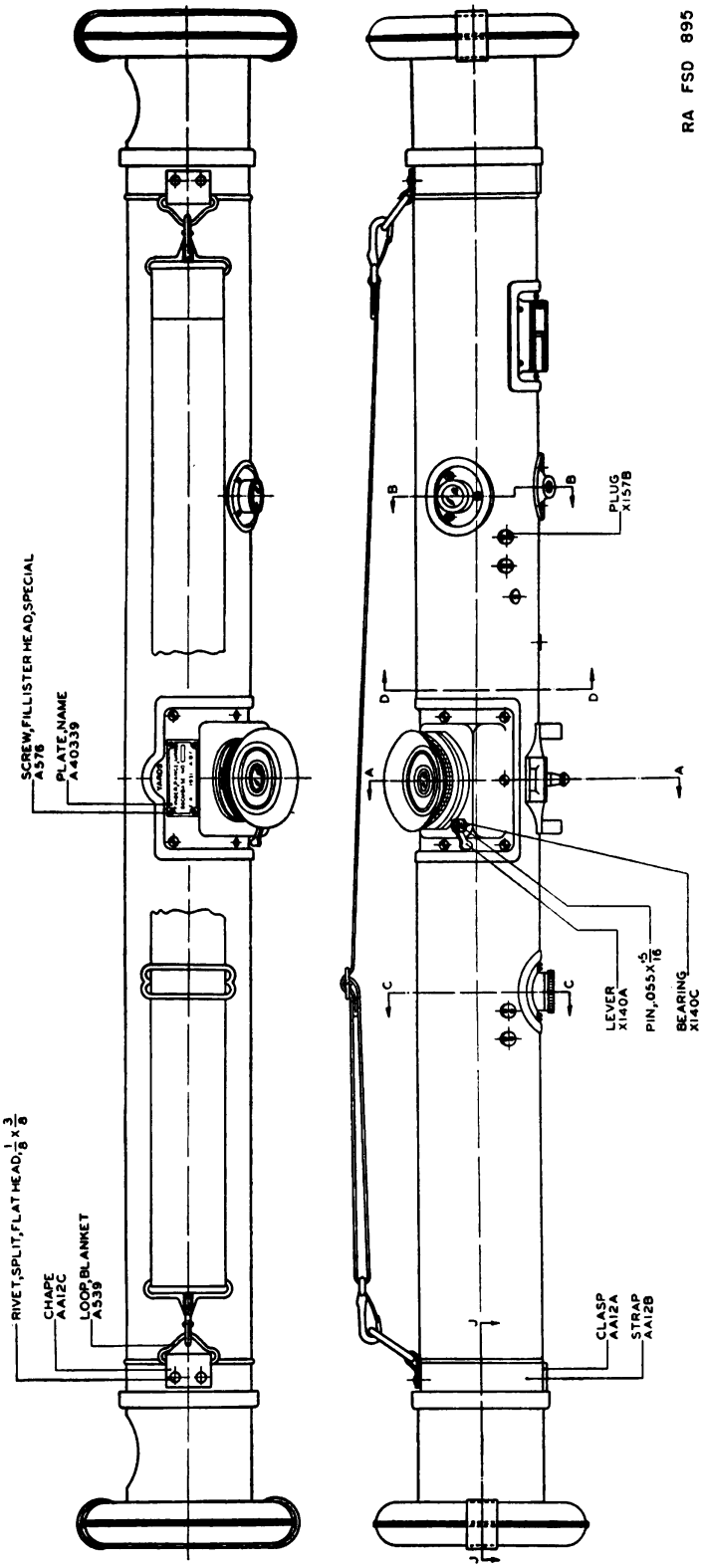


FIGURE 58.—80-cm base range finder, M1917MI—assembled views.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:31 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

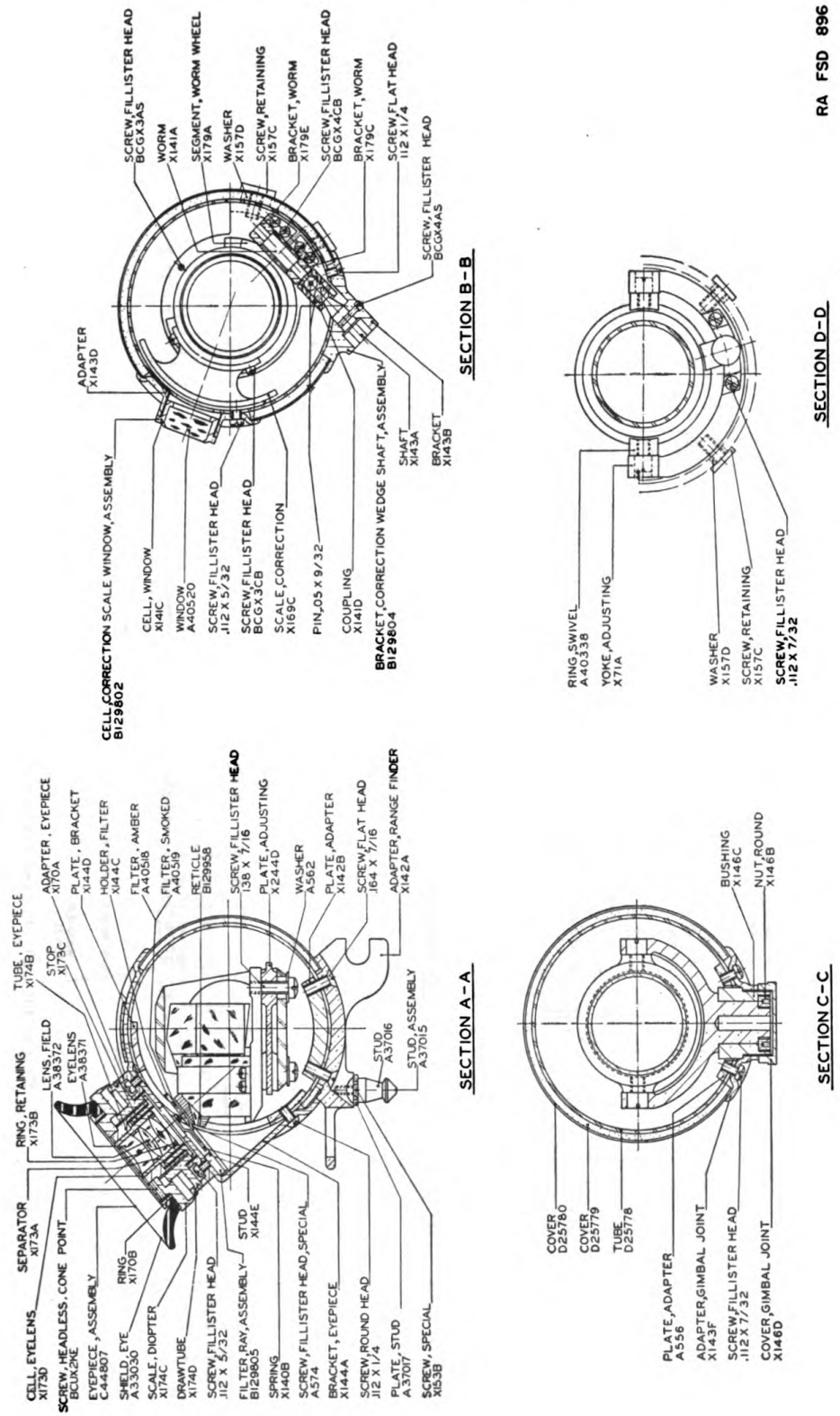


FIGURE 59.—80-cm base range finder, M1917MI—sectioned views A–A to D–D.

Generated on 2017-02-23 18:32 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

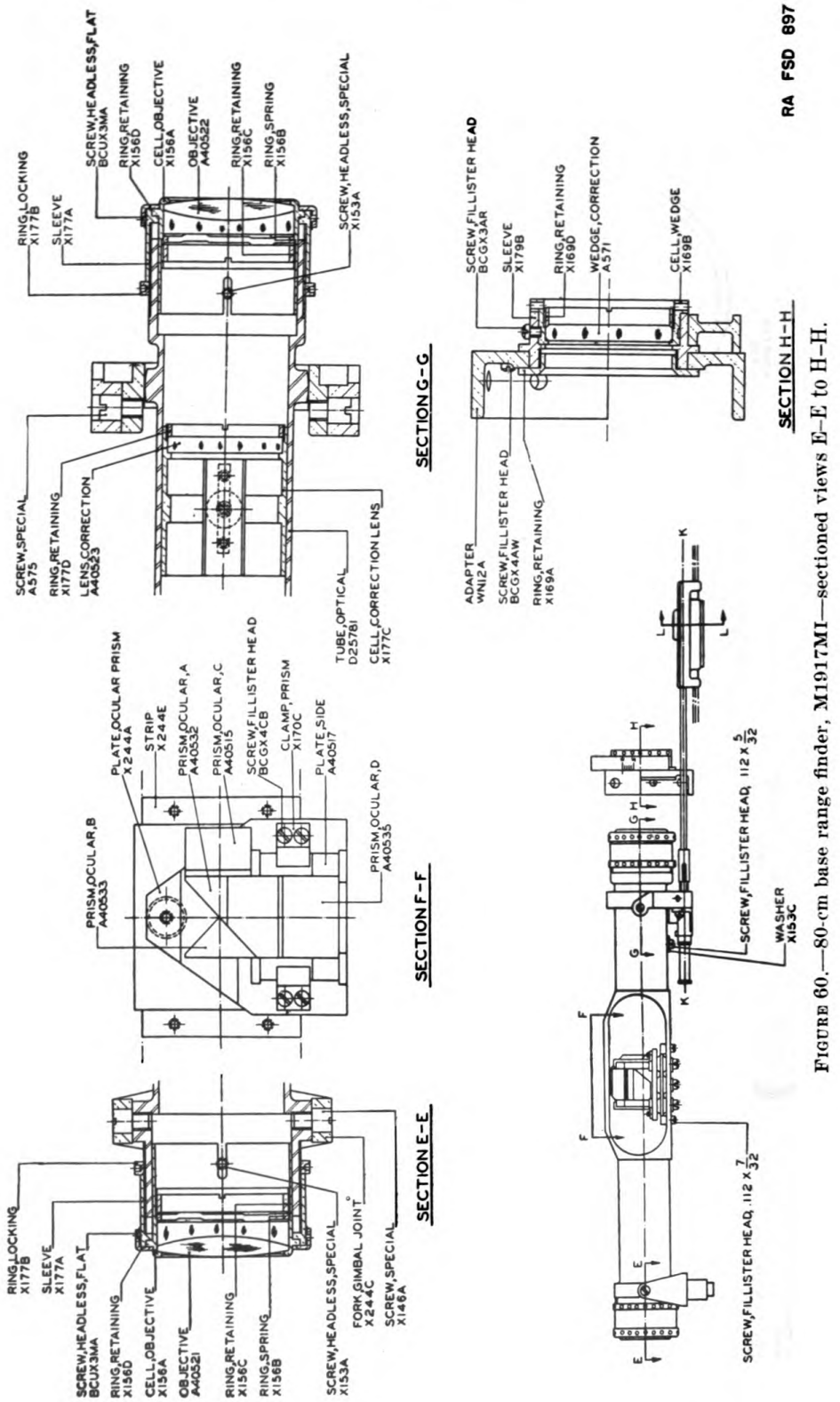


FIGURE 60.—80-cm base range finder, M1917MI—sectioned views E–E to H–H.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:32 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

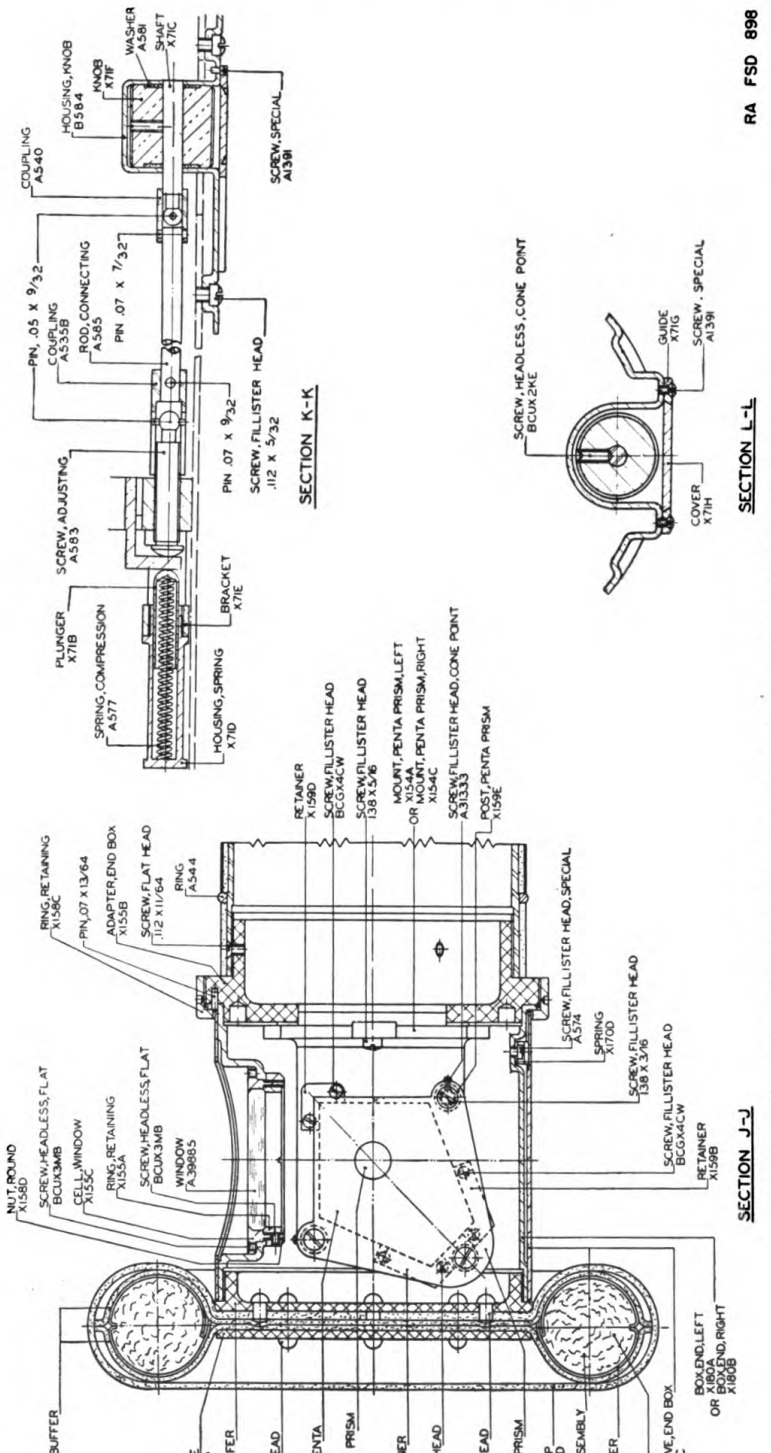


FIGURE 61.—80-cm base range finder, M1917MI—sectioned views J–J to L–L.

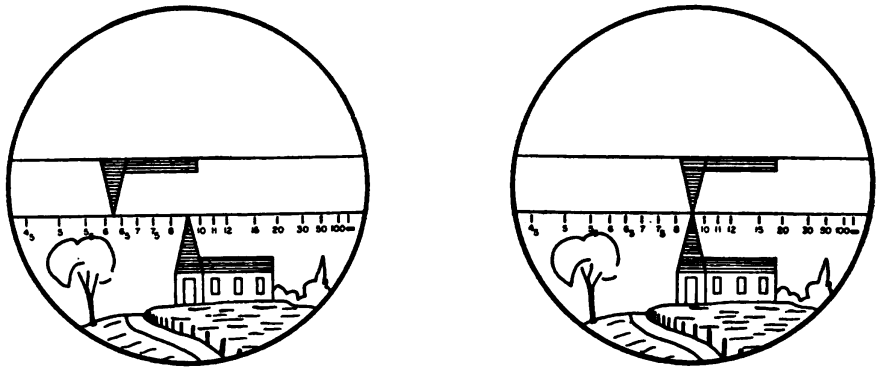
Generated on 2017-02-23 18:32 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

securely. Do not tighten round nut, X146B, until halving adjuster has been coupled. The round nut should then be firmly tightened.

(3) Couple halving adjuster, setting it midway in its movement.

(4) Replace range finder adapter, X142A (section A–A).

(5) Replace eyepiece bracket, X144A, to marked position. An auxiliary threaded rod will be found necessary to properly hold and locate the eyepiece bracket plate.



① ②

FIGURE 62.—Fields of view.

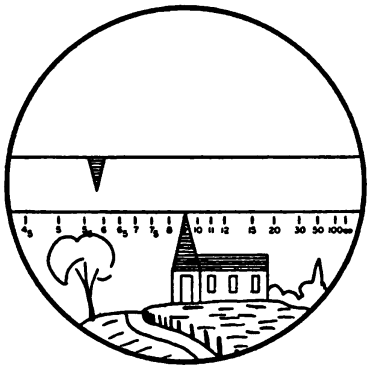


FIGURE 63.—Incorrect halving adjustment.

(6) Replace correction wedge mounting adapter, WN12A (figs. 56 and 60).

(7) Replace correction wedge shaft bracket, X143B (figs. 55 and 59), and coupling, X141D.

(8) Replace correction wedge window adapter, X143D, with window and cell. If screws are of different lengths, use a short screw at the bottom to prevent scratching the scale. Set scale at 15.

(9) Replace end box adapter, X155B (figs. 57 and 61), to marked position and replace the flat head locking screws in outside tube.

(10) Replace right penta prism mount, X154C.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:32 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

(11) Replace end box, X180B, to marked position. Secure with retaining ring, X158C.

(12) Check whether the image varies from or into the halving line by bringing several objects at successively increasing distances into coincidence at the halving line. The objects should hold the same relative position across the field. If halving cannot be maintained, correct by temporarily loosening the three fillister head screws which secure the penta prism mount and shifting the mount slightly as required. The left penta prism mount should not require adjustment as it has not been removed.

(13) For final coincidence and halving adjustment, it may be necessary to rotate the end box window (wedge) until halving and coincidence are as nearly correct as possible. It may also be necessary after this adjustment to reposition the penta prism mount as in (12) above.

(14) Replace end box sleeve.

(15) Replace right end buffer assembly.

SECTION VII

80-CM BASE RANGE FINDER, M1918

22. Description.—The 80-cm base range finder, M1918, complete, consists of the range finder, tripods, types N and P, adjusting lath, type A, carrying strap, and carrying cases.

a. 80-cm base range finder, M1918.—The optical system of this range finder is shown in figure 64. Mechanical details are shown in figures 65 to 70, inclusive.

(1) The eyepiece is focused by moving the handle, 11A (fig. 68), of the eyepiece focusing ring, 11B, on which is engraved the diopter scale. An object viewed through the eyepiece presents two images—the lower image erect and the upper inverted, separated by a horizontal dividing line known as the halving line. A ray filter holder, 11R, containing an amber ray filter, A39854, a smoked ray filter, A39855, and a clear ray filter window, A39794, rotates within the eyepiece housing, 11Q, and is controlled by means of the knurled edge which protrudes from the housing. The open sight, 28B (fig. 65), near the eyepiece facilitates training of the range finder on the desired object. The left eye guard, 28A (fig. 68), is blank.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:33 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

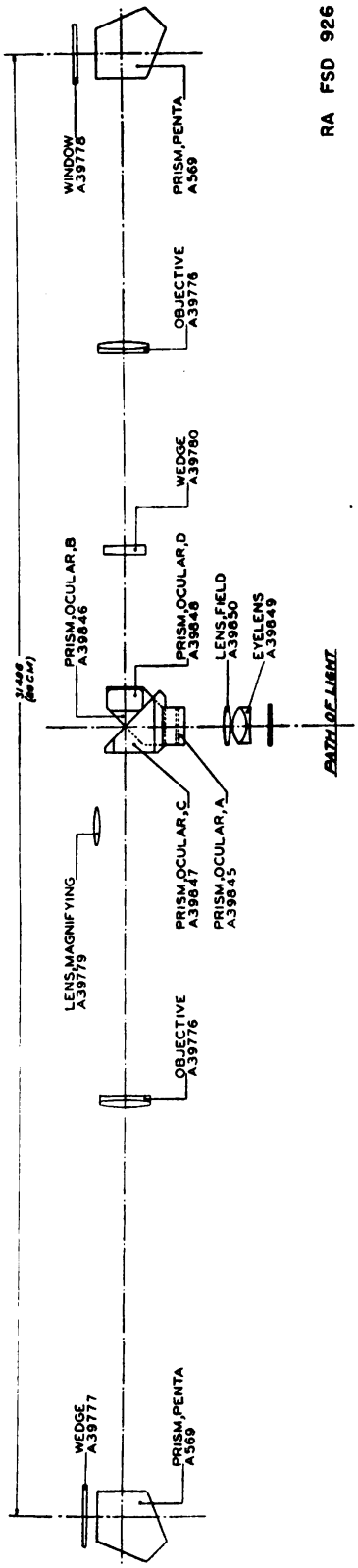


FIGURE 64.—Optical system for 80-cm base range finder, M1918.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:33 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

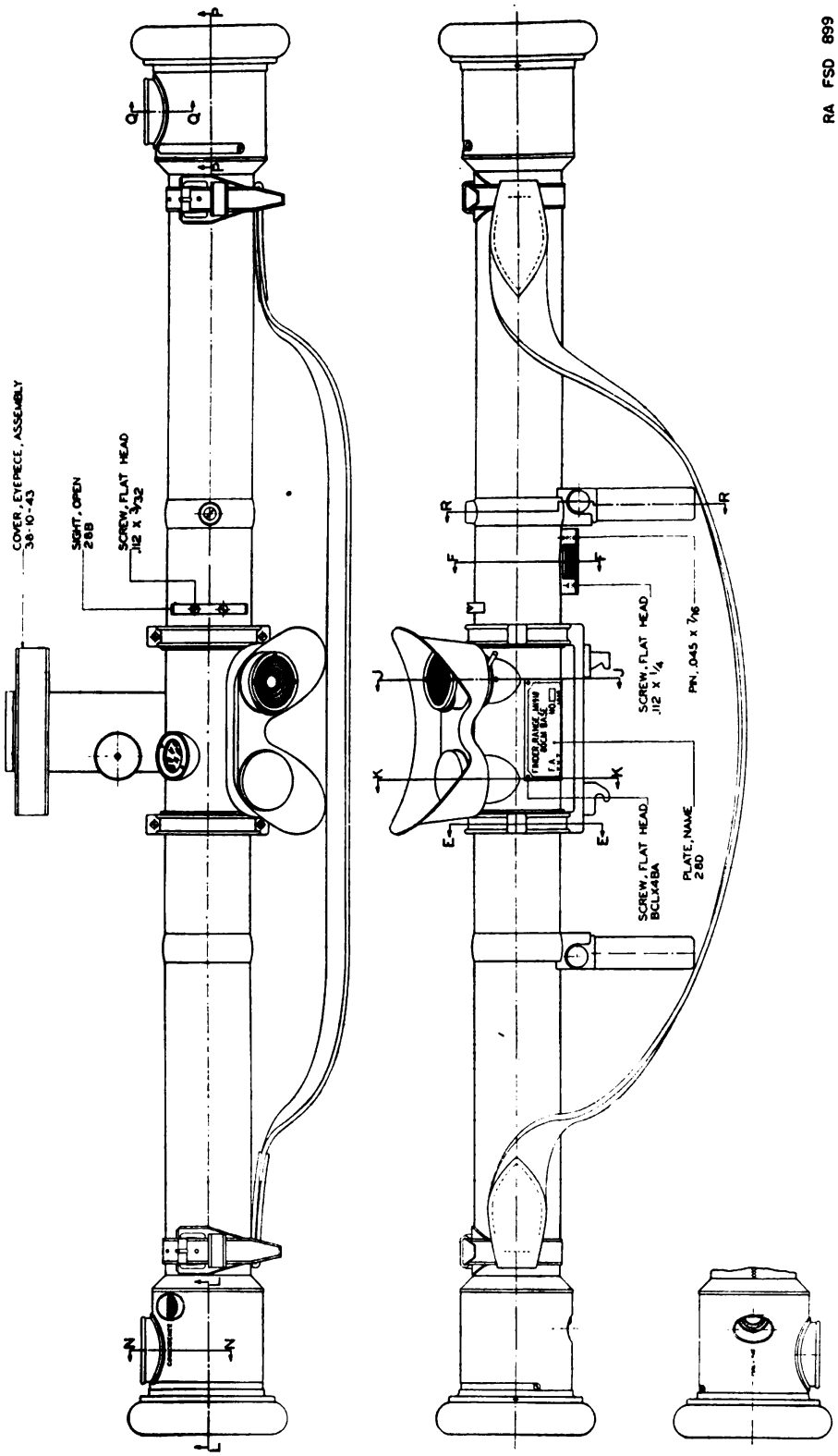


FIGURE 65.—80-cm base range finder, M1918—assembled views.

Generated on 2017-02-23 18:33 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

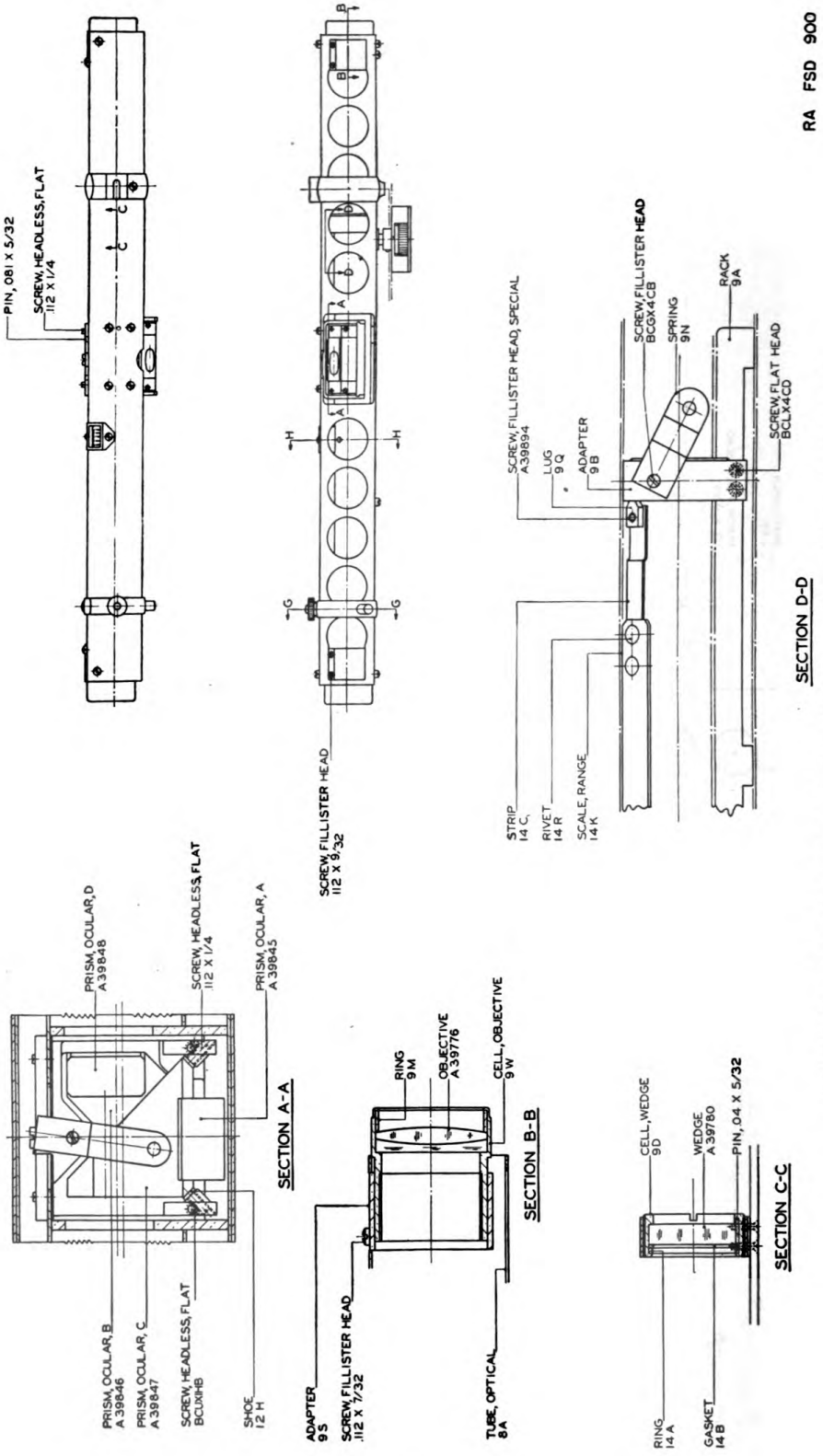


FIGURE 66.—80-cm base range finder, M1918—sectioned views A–A to D–D.

Generated on 2017-02-23 18:33 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

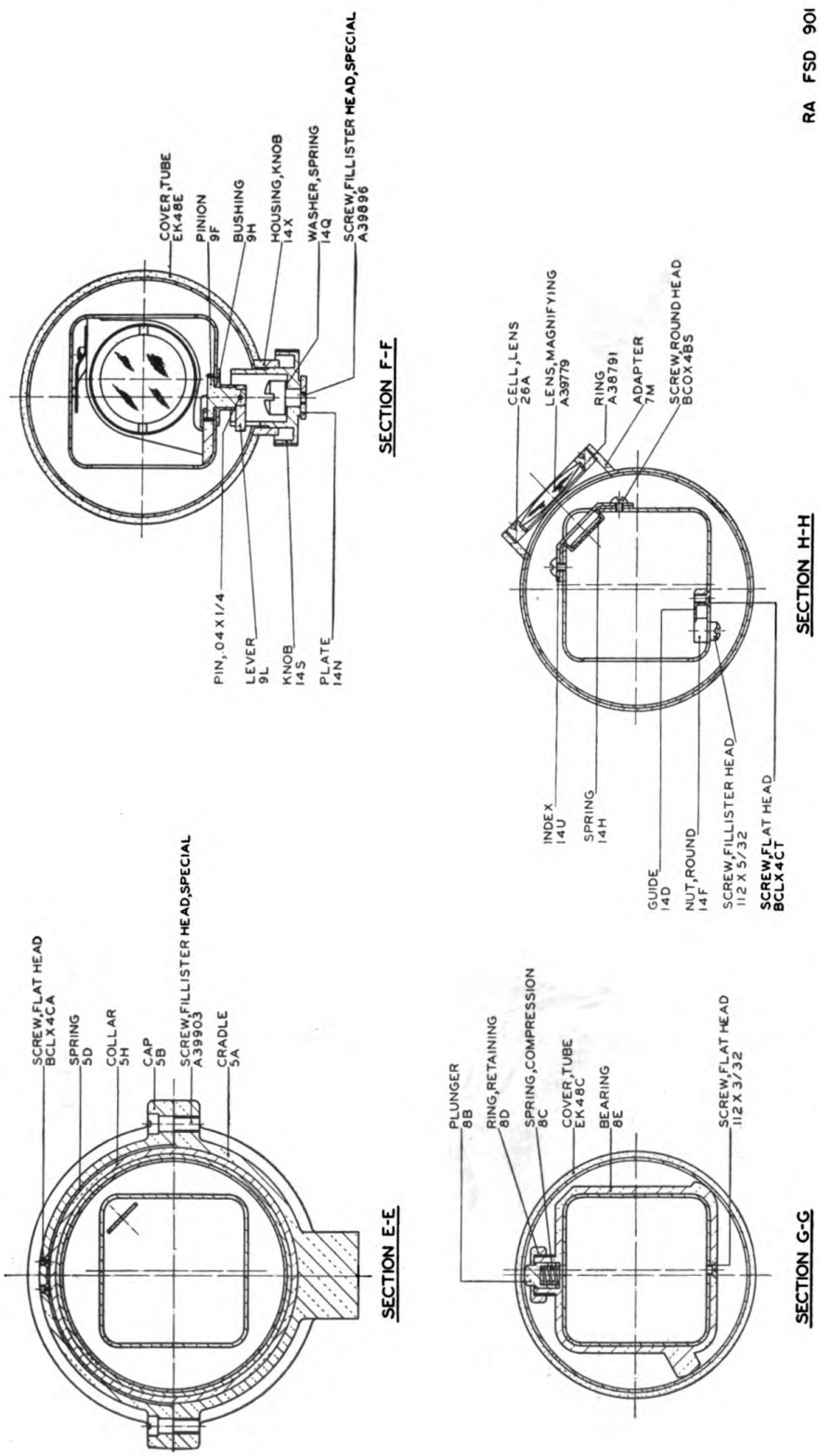


FIGURE 67.—80-cm base range finder, M1918—sectioned views E–E to H–H.

Generated on 2017-02-23 18:33 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

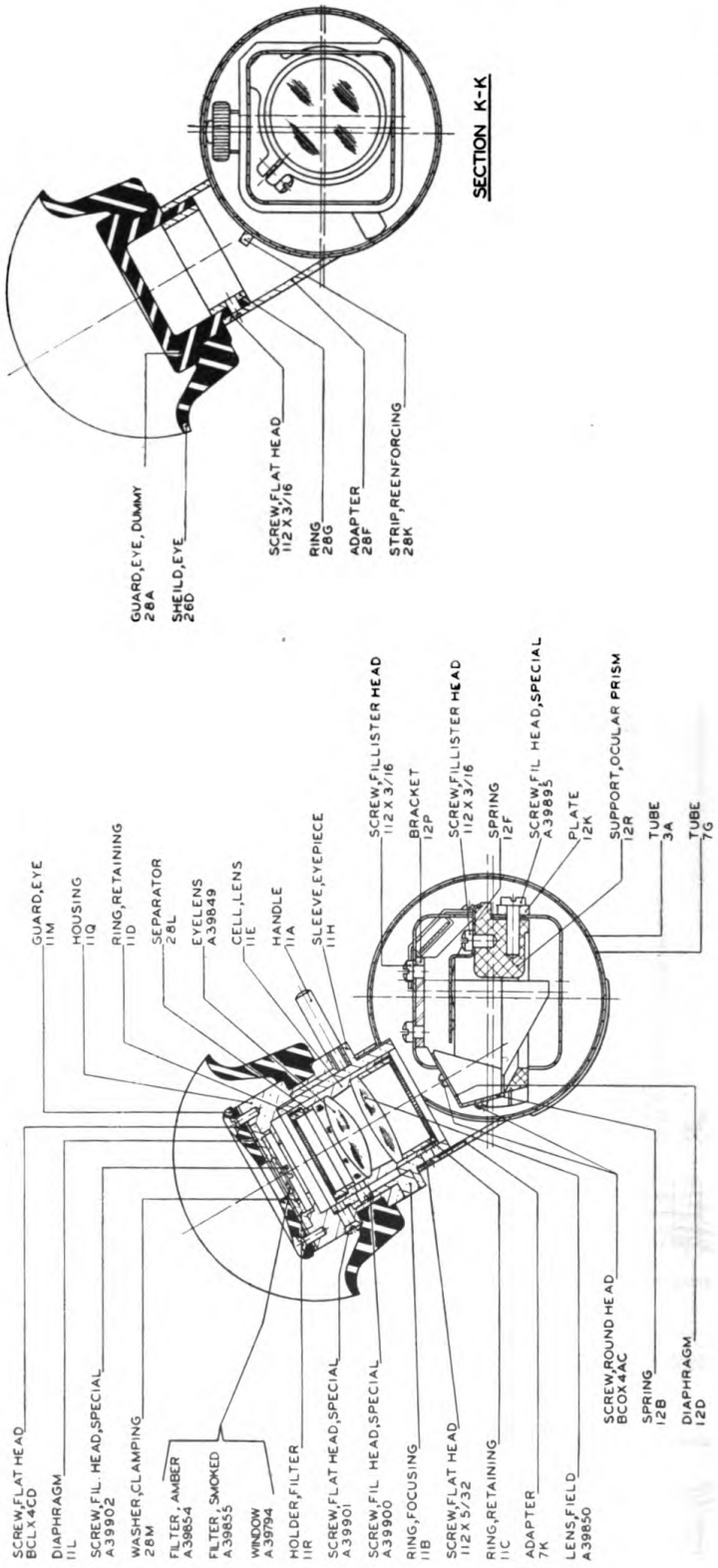


FIGURE 68.—80-cm base range finder, M1918—sectioned views J–J and K–K.

Generated on 2017-02-23 18:33 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

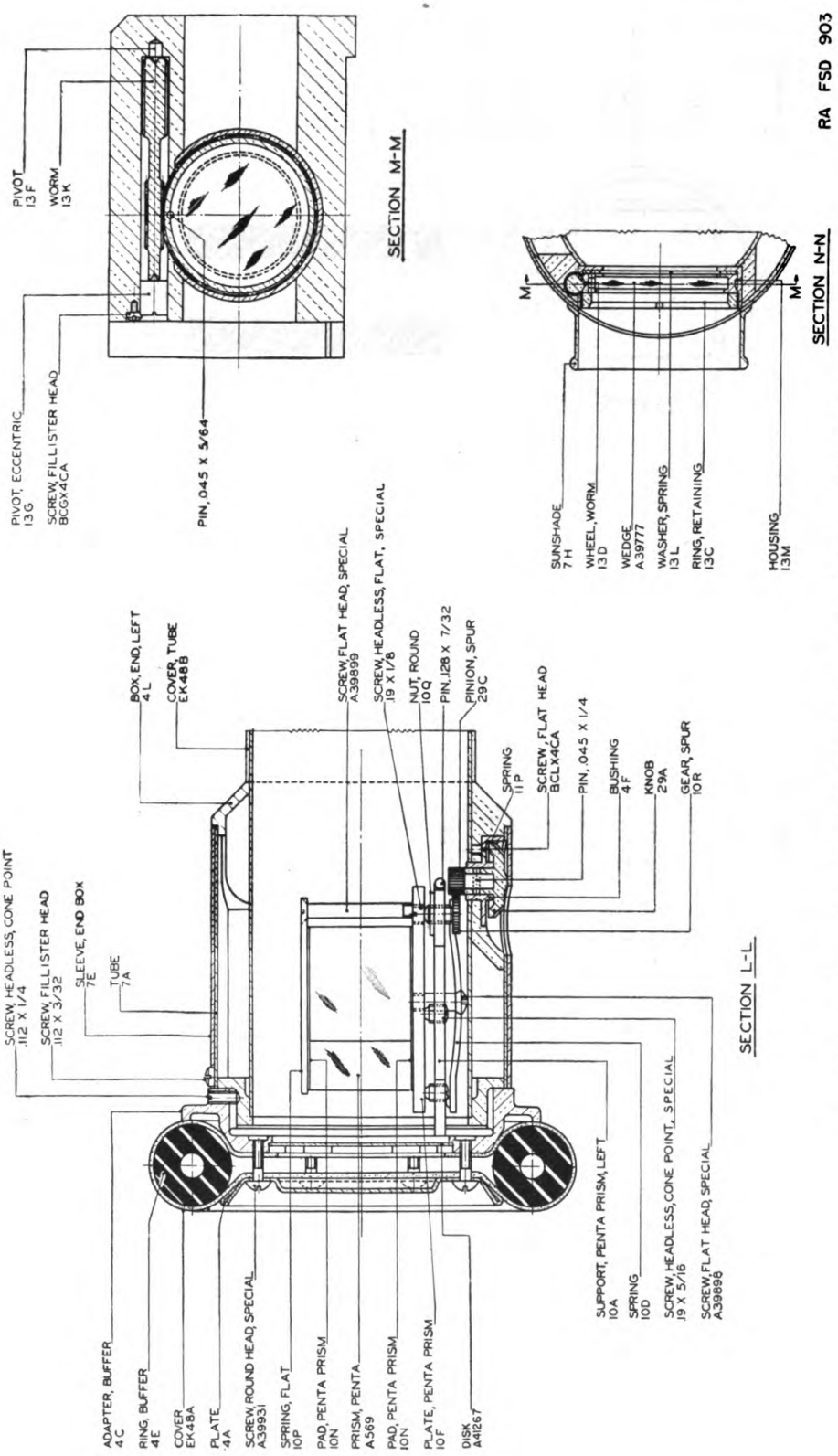


FIGURE 69.—80-cm base range finder, M1918—sectioned views L–L to N–N.

Generated on 2017-02-23 18:34 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

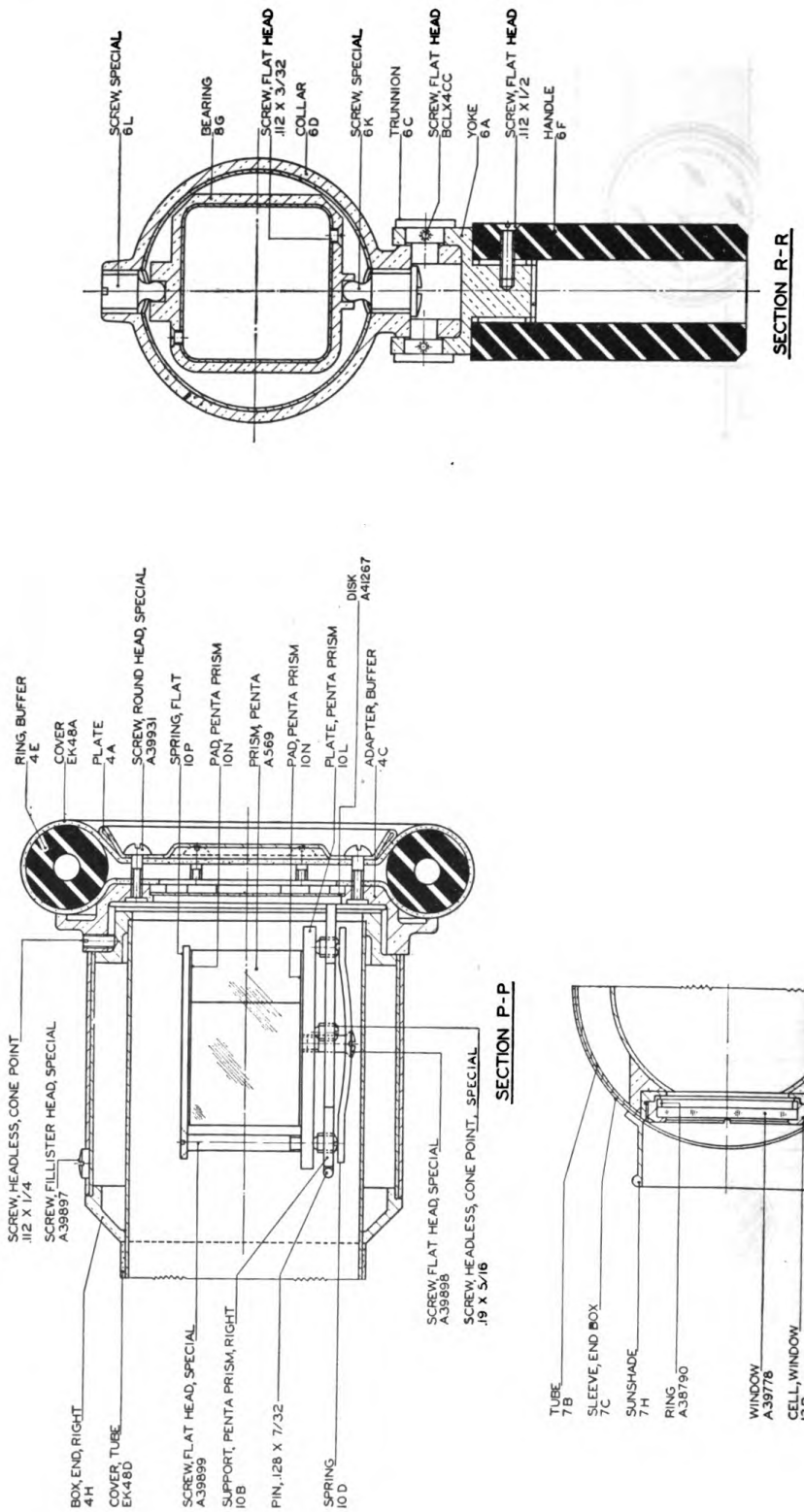


FIGURE 70.—80-cm base range finder, M1918—sectioned views P–P to R–R.

Generated on 2017-02-23 18:33 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

(2) The measuring wedge knob, 14S (fig. 67), is located on the under surface of the outside tube, 3A (fig. 68). This knob actuates the measuring wedge, A39780 (fig. 66), and range scale, 14K. The range scale is graduated in yards from 400 to 10,000 and is marked with a star (*) to indicate the infinity point. The scale is visible through the magnifying lens, A39779 (fig. 67), near the eyepiece and is read against the line of the range scale index, 14U.

(3) The left end box, 4L (fig. 69), contains the mechanisms for performing the halving adjustment and the range adjustment. The halving adjusting knob, 29A, by shifting the position of the penta prism, A569, within the end box, controls the symmetry of the eyepiece images. The end box wedge adjusting worm, 13K, controls the calibration of the range scale at coincidence. The left end box sleeve, 7E, contains openings marked "halving" and "coincidence" which are for access to the corresponding knobs. Both the left and right end box sleeves can be rotated to cover the objective openings.

(4) The cradle, 5A (fig. 67), in which the tube rotates is the means for attaching the range finder to the support on the upper portion of the tripod, type P. The range finder handles, 6F (fig. 70), provide a convenient means for turning the range finder in elevation or azimuth; they can be folded back when not in use. The buffer assemblies are provided as a protection against minor shocks.

(5) The optical characteristics of the range finder are as follows:

Power	10X.
Field of view	3°30′.
Diameter of exit pupil	0.10 inch.
Aperture of objective	1.0 inch.

b. Tripods, types N and P.—The tripod, type P, is a short tripod with legs that can be folded together so as to fit into the head of the tripod, type N, as shown in figures 48 and 50, or spread to form an independent tripod structure. The head of the tripod, type P, contains a knuckle joint which permits leveling of the range finder and also permits the use of the range finder in a vertical position when ranging on objects having horizontal relief. The support, X235A (fig. 50), is formed with a latching plunger, X234A, which holds the range finder securely in position. The clamping screw, X234F, when released permits rotation of the range finder in azimuth. The tripod, type N, shown in figure 49, is a larger tripod which is designed specifically for use in conjunction with the tripod, type P. When so used, the tripod, type P, functions as a mount for the range finder. The legs of the tripod, type N, are extensible.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:34 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

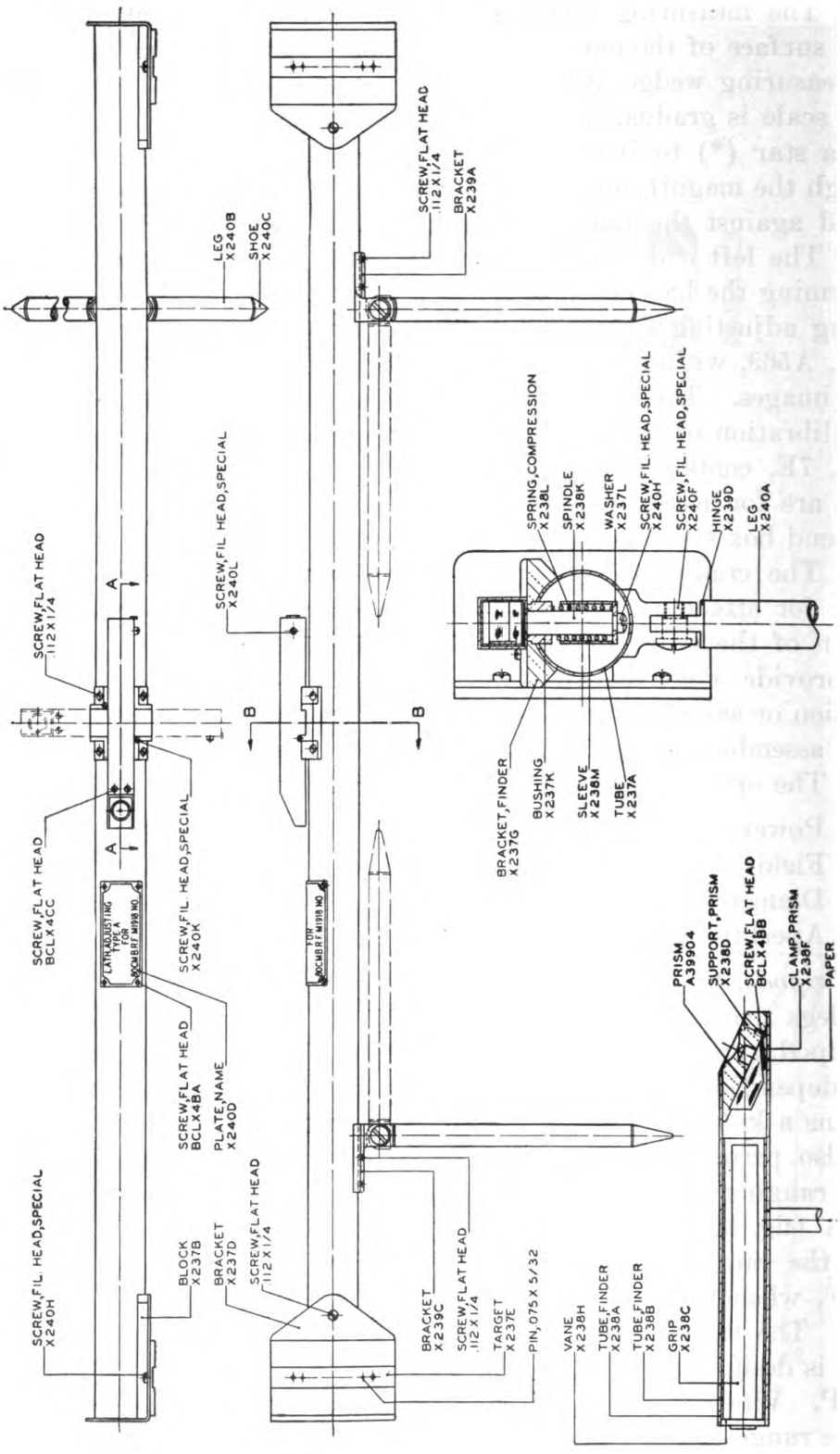


FIGURE 71.—Adjusting lath, type A—assembled and sectioned views.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:34 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

c. Adjusting lath, type A.—The adjusting lath, type A (figs. 51 and 71), consists essentially of a body tube, X237A (fig. 71), carrying a target bracket, X237D, and target, X237E, at each end. The body tube is mounted on collapsible legs and is fitted with a finder assembly for alining the lath with the range finder when adjusting. Each adjusting lath is individually adjusted so that the distance between the targets is equal to the base of the range finder, and the laths are therefore not interchangeable. Each adjusting lath bears the same serial number as the range finder.

d. Carrying cases.—The carrying case for range finder and tripods is shown in figure 52. The tripods, types N and P, fit into the pocket on the side of the case and are secured by means of the hood and fastening strap. The lid of the carrying case is formed with a tool pan which is covered by the lid cap and which is used for carrying small items of equipment such as the camel's-hair brush. A separate carrying case is provided for the adjusting lath. Before placing the adjusting lath in the carrying case, the legs should be folded in against the body tube and the finder should be turned so that it is parallel to the body tube.

23. Operation.—*a. Range measurement.*—(1) To measure the range of an object, select a clearly defined part, perpendicular, if possible, to the halving line. Move the instrument in azimuth and elevation as required to bring the part to the center of the field of view. When first observed, the images will ordinarily not be in coincidence (fig. 19①). Turn the measuring wedge knob until the images of the point selected appear in coincidence (fig. 19②). Read the range, in yards, on the range scale, opposite the index.

(2) Ranges of objects which have no prominent vertical parts, such as roads, trenches, crests of ridges, etc., can be measured by loosening the wing nut of the tripod, type P, and rotating the range finder to a vertical position. The images when first observed will ordinarily not be in coincidence (fig. 19③). Turn the measuring wedge knob until the image of the horizontal line appears to continue across the halving line (as at A in fig. 19④).

b. Field adjustment.—(1) *Halving adjustment.*—Incorrect adjustment of the halving line is indicated by the failure of the corresponding points on the inverted and erect images to fall on the halving line (fig. 20). To correct the halving adjustment, turn the end box outer sleeve to expose the opening marked "halving," and rotate the halving adjusting knob until the corresponding point of each image touches the halving line (as in fig. 19① and ②). A sharply defined point at least 400 yards away must be used for this adjust-

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:34 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

ment. Return the sleeve to its original position when the adjustment is completed.

(2) *Range indications.*—(*a*) To test the instrument using a finite range, select a sharply defined object at a distance of 400 yards or more, the range of which is accurately known, and bring the object into coincidence in the center of the field of view (fig. 19②). If the range adjustment is correct, the known range should be indicated.

(*b*) To test the instrument by the infinity method, set up the adjusting lath in a horizontal position at least 125 yards from the instrument (use the finder of the lath to insure perpendicularity to the line of sight), and set the range scale to indicate infinity (*). If the images appear alined as in figure 21② the adjustment is correct; misalinement, such as shown in figure 21①, indicates the necessity for adjustment.

(*c*) To adjust the instrument in range, set the range scale at the known range or at infinity, depending on the method of test employed, and bring the images into correct relation by rotating the end box wedge adjusting worm.

(*d*) When the adjusting lath is used, it must be the one belonging with the particular range finder. The same serial number is provided on both.

24. Inspection.—Inspection is for the purpose of determining the condition of the instrument, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning.

a. Range finder.

Parts to be inspected	*Points to be observed*
(1) Exposed mechanical parts.	(1) Observe general appearance, smoothness of operation of knobs, end box sleeves, ray filter holder, etc., and bent or missing parts.
(2) Open sight.	(2) Line of sight should intersect optical line of sight within a tolerance of approximately 10 mils.
(3) Eyeshield.	(3) The eyeshield requires replacement if torn or otherwise damaged.
(4) Optical system.	(4) Note if checks or frost patterns appear in the field of view. Such defects are evidence of loosening of the balsam used in cementing prisms and lenses and, if severe, require the

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:34 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Parts to be inspected	*Points to be observed*
	return of the instrument to an arsenal for overhaul.
(5) Eyepiece focusing ring.	(5) Using the collimating telescope (optical repair kit, No. 90) focus the eyepiece for sharpness and clearness of definition of the halving line and of both images. The reading of the diopter scale at optimum focus should be aproximately zero.
(6) Halving adjustment.	(6) Adjust the range finder to correct halving. If proper adjustment cannot be obtained, or if halving adjusting knob is very near its limit, halving adjusting mechanism requires overhaul.
(7) Coincidence adjustment.	(7) Adjust instrument for range, preferably using a datum point of known range. If proper adjustment cannot be obtained, or if end box wedge adjusting worm is very near its limit, the penta prism or end box wedge is out of adjustment.
(8) Prisms.	(8) Check a sharply defined object for halving at each edge and at the center of the halving line. If halving cannot be maintained without readjustment, it is an indication that the ocular or penta prisms have shifted.
b. Adjusting lath.	
(1) Exposed mechanical parts.	(1) Note loose or missing screws and any damaged parts. See that the legs fold properly and that the finder operates as intended.
(2) Name plate.	(2) Serial number of adjusting lath should be the same as range finder.
(3) Straightness.	(3) If bent so that the space between index lines is shortened, the lath should be corrected.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:34 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Parts to be inspected	*Points to be observed*
(4) Alinement.	(4) Set up the range finder on its tripod or on V-blocks (optical repair kit, No. 75). Place the adjusting lath at a distance of 125 yards in front of the range finder and parallel to it so that the range finder appears in the center of the field of view when sighting through the finder of the lath. Check the range adjustment against a fixed reference target at medium distance (500 to 2,000 yards), the range of which is accurately known. Make four or five check readings and then set range scale to read infinity. Direct the range finder on the adjusting lath. If the targets are in coincidence, they are properly spaced.

25. Maintenance and repair.—Repairs which necessitate disassembling and assembling operations are limited to those which do not affect the optical alinement of the instrument. Repairs involving realinement, removal or replacement of optical parts, or other repairs which cannot be made with the facilities available will require that the instrument be turned in to the base shop.

a. Eyepiece.—To disassemble the external eyepiece parts remove the three flat head screws securing the eye guard and lift off the eye guard, eyepiece diaphragm, and ray filter holder. To release ray filters, remove screw holding ray filter clamping washer to ray filter holder. If ray filter holder is too loose or too stiff in operation, bend detent portion of eyepiece diaphragm in or out as required. Clean eyelens before reassembling parts.

b. Range finder handles.—Handles are threaded in place and secured by flat head locking screws. The special screw, 6K (fig. 70), in the right handle collar supports the optical tube and is not to be disturbed in disassembling the handle.

c. Halving adjustment.—The pair of special screws, 6L and 6K, in the right handle collar positions the ocular tube within the outside tube and hence serves to locate the halving line when the penta prisms have been properly set. Adjustment is required only where obvious misalinement of the optical tube is indicated, and should not be attempted where the penta prisms are known to be out of position.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:34 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

SECTION VIII

CARE AND PRESERVATION

26. Care in handling.—*a.* The range finders described herein contain delicate mechanisms and accurately arranged optical parts and should therefore be handled gently to avoid unnecessary shocks.

b. The range finder should never be sighted directly at the sun, as the heat of the focused rays will melt the balsam used in cementing the ocular prism assembly.

c. When using the azimuth worm throw-out lever of the mount for 1-meter base range finder, M1916, care should be taken to rotate the lever sufficiently to prevent scraping of the worm on the teeth of the worm gear, as such action will eventually damage the teeth and cause inaccurate readings.

d. Moisture due to condensation may collect on the optical parts of the instrument when the temperature of the parts is lower than that of the surrounding air. This moisture, if not excessive, can be removed by placing the instrument in a warm place. Heat from strongly concentrated sources should never be applied directly, as it may cause unequal expansion of parts with resulting inaccuracies in observation.

e. For general regulations pertaining to the care and preservation of instruments refer to TM 9–850 (now published as TR 1395–A).

27. Lubrication.—The range finders will ordinarily require no lubrication while in the field. They should be kept clean from any excess lubricant, and no lubricant should be allowed to enter the interior or come in contact with optical surfaces. Exposed moving parts of accessories should be lubricated sparingly with the lubricants furnished by the Ordnance Department for fire control instruments. The lubricants commonly used are aircraft instrument and machine gun oil and Royco 6A. Royco 6A is used where a soft or medium grease is required.

28. Optical parts.—*a.* To obtain satisfactory vision, it is necessary that the exposed surfaces of the lenses and other parts be kept clean and dry. Corrosion and etching of the surface of the glass can be prevented or greatly retarded by keeping the glass clean and dry.

Generated on 2017-02-23 18:34 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

b. For dusting optical parts, use only a clean camel's-hair brush. For wiping, use only paper specially intended for cleaning optical glass. Use of cleaning cloths in the field is not permitted.

c. To remove oil or grease from optical surfaces, apply ethyl alcohol with a clean camel's-hair brush and rub gently with clean lens paper. If alcohol is not available, breathe heavily on the glass and wipe off with clean lens paper; repeat this operation several times until clean.

d. To remove dust, brush the glass lightly with a clean camel's-hair brush and rap the brush against a hard body in order to knock out the small particles of dust that cling to the hairs. Repeat this operation until all dust is removed.

e. Do not wipe the lenses or windows with the fingers.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:34 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

APPENDIX

LIST OF REFERENCES

1. Standard nomenclature lists.

80-cm base range finder, M1917, M1917MI	SNL F–20.
Optical repair kit for Field Artillery	SNL F–21.
80-cm base range finder, M1914, M1914MI	SNL F–25.
1-meter base range finder, M1916	SNL F–26.
80-cm base range finder, M1918	SNL F–39.
80-cm base range finder, M1916	SNL F–89.
Tripods (all active types)	SNL F–101.

2. Technical manuals.

Cleaning and preserving materials—TM 9–850 (now published as TR 1395–A).

Matériel inspection and repair—TM 9–1100.

[A. G. 062.11 (3–27–41).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

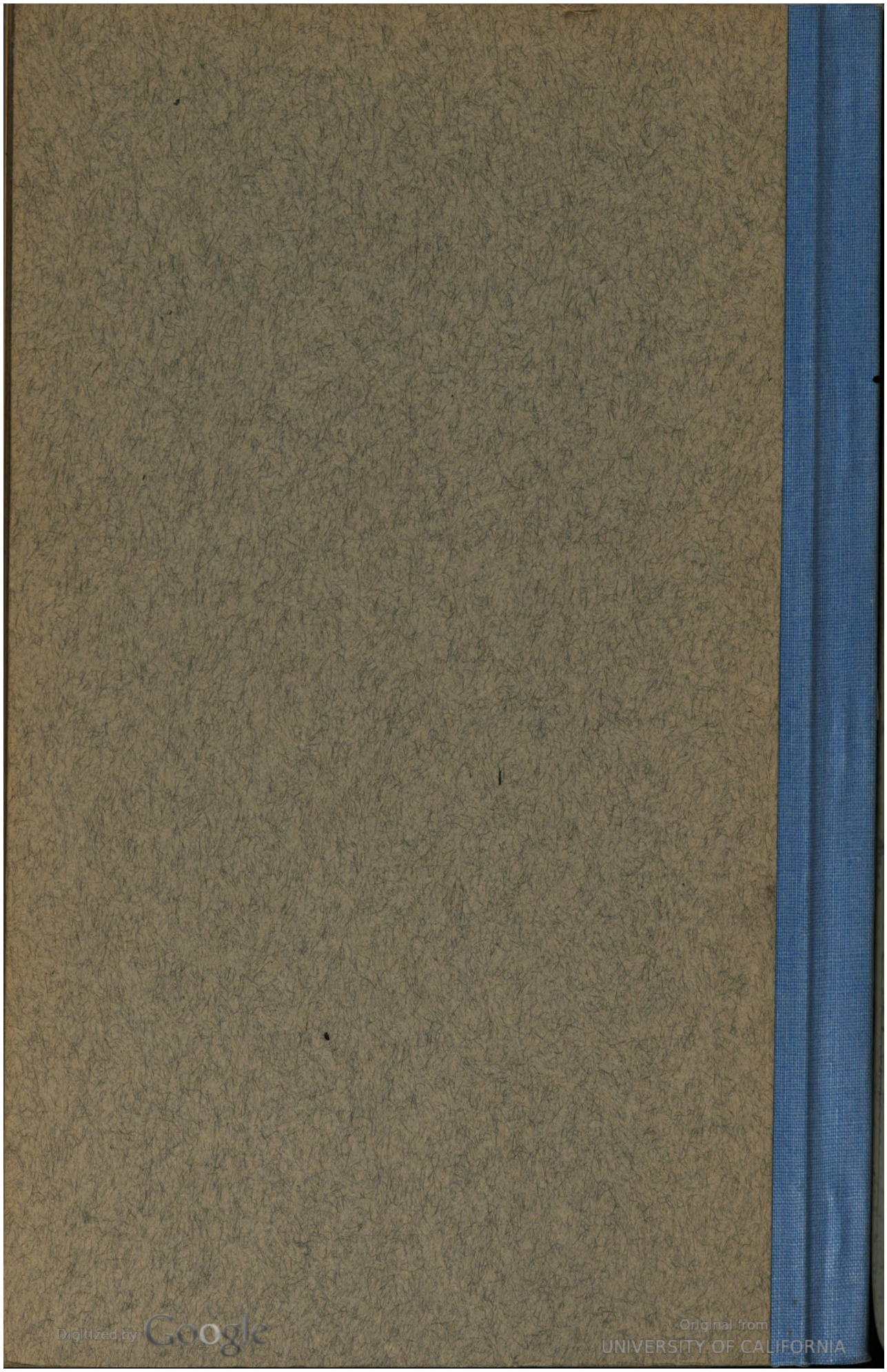
DISTRIBUTION:

D 7 (3); B 7 (2); R 7 (5); Bn 9 (3); IC 7, 9 (4).

U. S. GOVERNMENT PRINTING OFFICE: 1941

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - Price 15 cents

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:35 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google


Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated on 2017-02-23 18:36 GMT / http://hdl.handle.net/2027/uc1.b3243924
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google